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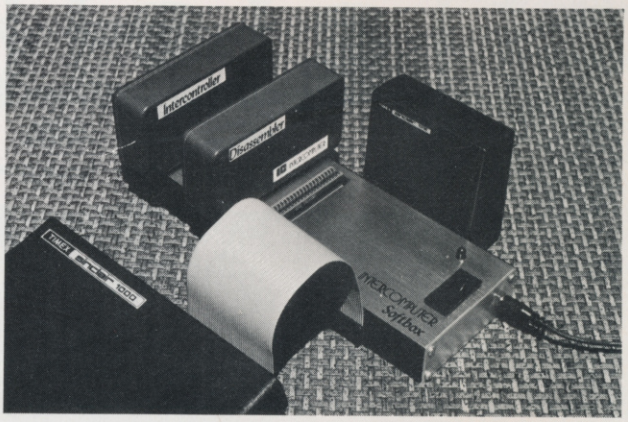

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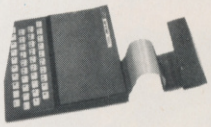

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Programming Arcade Games, page 58.

T/S Entrepreneurs, page 54.

SOFTWARE 4
Ten new reviews and the "Previously Reviewed" capsules
LETTERS 9
In which our readers have their say
TIMEXPECTATIONS 11
Can Timex maintain its image of clocklike efficiency?
BOOKS 12
Logan's and O'Hara's ROM disassembly guide is invaluable
COVER 14
Jim Stephens shows how to convert your computer to color
HOW TO PROGRAM 26
In the last part of his series, John Gilbert deals with finding bugs
PROGRAM PRINTOUT 28
Compoetry, Video Graphity, Kingdom Revisited and other great programs
HARDWARE 38
A high-resolution non-glare screen monitor; and more
NEWS 40
Timex is expediting delivery of the long-awaited 2000-series
FEATURE 41
Kwikplot: a program for investigating correlations
IN-DEPTH 47
Merging in BASIC: How to do what the manual says you can't
U.K. WINDOW 51
Britain's software pioneer days are over
HINTS & TIPS 52
On locking your computer, saving memory, rubber bands and more
USER GROUPS 54
Four companies have sprung from one Pennsylvania group
USER GROUPS 56
Is your group included in our updated listing?
FEATURE 58
How to Program Arcade Games: Part 1 of a series by Bob Fraser
BULLETIN BOARD 62
New products and information of interest to T/S users

Next month

- Joysticks for your T/S
- Programming Arcade Games Part II

and much more!

Reviews

Spaced Out

MOTHERSHIP

Softsync, 16K

The object of Mothership is to protect your Starlight Fighter Ship from the attacking Mothership as you race down the Zarway space corridor. You accumulate points by direct hits on the Mothership's missiles. There are three levels of play, with a one or two player option.

The graphic effects are excellent in this fast-paced, arcade-style game. You can fly your Starlight Fighter through the space corridor (being careful not to crash into the walls), or just lay low and blow up the drone fighters sent out by the Mothership. The one or two player option lets you pit your maneuvering skill against other fighter pilots, and the different levels of play add to the versatility and fun of this game. My high score so far is 16,300. See if you can beat that! ★★★

For more information, circle 2 on reader service card.

11 Varieties

GAMESTAPE 1

Melbourne House, 16K

This tape holds 11 games for the unexpanded T/S1000. Although their quality is not uniform, the variety is impressive, and Klingons, Code, Asteroids and Breakout are good enough in themselves to justify purchasing this tape. In Klingons you try to ram the ships approaching you; Code is a guessing game along the lines of Mastermind; Asteroids gives you only one direction control to avoid hunks of debris; and Breakout is a ball and paddle game with a twist. Others include Simon, a word version of the popular children's game; UFO, a shooting gallery type of game; Bomber, in which you get ten runs to destroy a dam; and Guillotine, which is Hangman revisited. For players accustomed to a larger memory capacity, the games may prove frustrating in their simplicity. ★★★

For more information, circle 3 on reader service card.

Fore!

GRAPHIC GOLF

Mindware, 16K

Graphic Golf takes you to the first hole on an 18 hole game of golf. As in real golfing, the object is to play each hole under par. The golfer encounters such obstacles as sand traps, trees and water, and must also cope with wind, which can affect the direction of a shot.

This game allows you to play golf in any weather without special equipment. When you tee off at each hole the computer is your caddy, asking you to choose your golf club (choice of wood, iron, or putter), and club size. You are then asked to indicate the direction the ball is to travel (up, down, left, right), the angle it is to take, and the driving force behind your shot. If you lose your ball in the trees or water you must tee off again. Each hole is clearly displayed in graphics, and all 18 are different. After playing each hole you are given a running tally as well as your score for the hole just played. Graphic Golf is an absorbing game which relies on skill and good judgment. The player sets his own handicap so it is possible to increase the difficulty of the game as your skills improve. ★★★

For more information, circle 4 on reader service card.

Superlative

MAZOGS

Bug Byte, 16K

Wow! This is one of the best programs I've ever seen. I couldn't get to the machine to try it myself because my kids (ages 10 and 11) were always there! The graphics are really effective.

You are at the edge of a large and complicated maze. The maze contains several prisoners who will always help you find the treasure and the exit. There

Software

are also a number of swords, which are useful to fight the Mazogs you will encounter.

The game is played in the three levels of difficulty which correspond to difficult through suicidal. You have a view of just a tiny portion of the maze but can request a full screen view at any time.

If you don't have Mazogs you're missing the best game for Sinclair computers — it might be the best game for any computer. The whole family loved it! ★★★★

For more information, circle 5 on reader service card.

Batball

WALLBUSTERS

Beam Software, 1K

This batting game features speed and smooth action. The player has a choice of seven speeds, providing a challenge to experts as well as beginners. The object is to clear all three walls, involving a certain amount of skill. A limitation of the game is that in order to change the speed at which you are playing, the game must be reloaded. Also clearing all three walls ends the game. In play, however, this game should please any batting-game enthusiast. ★★½

For more information, circle 6 on reader service card.

Treasure Hunt

CAVES OF ZULU

Stuart Software, 16K

This combination word-adventure and maze game was created with humor and imagination. The object is to collect treasures hidden in a maze; as the player travels through, walls and hazards come into view. Each treasure is worth points, although nothing is done with your score other than adding it up. There are three levels of difficulty: level one is almost too easy, level two is good and level three is sometimes impossible. Graphics are used well to accent your moves. However, the game is very slow. There is also a tendency to go into a loop on one or two specific moves. This is, unfortunately, a good idea not reaching its full potential. ★★½

For more information, circle 7 on reader service card.

War Game

COMBAT FLIGHT

Melbourne House, 16K

Put yourself at the controls of a fighter ship flying over a mountain range with enemy ships approaching. This fast-paced, exciting game offers a variety of targets. At the end of play, the game allows you to enter your name if you have reached one of the top five scores. Despite the similarity of concept to numerous other games on the market, this version offers challenge and excitement. ★★★

For more information, circle 8 on reader service card.

For Budding Jedis

VAULT OF THE CENTAURS

Orbyte Software, 16K

In Vault Of The Centaurs you must capture the life fuel Zykon which your planet needs for continued survival. But the precious substance is carefully guarded deep within the vault. The Centaurs are your enemies and they are ruthless, highly-skilled fighters who zealously guard their Zykon.

There are five levels of play in this game, each more difficult than the last. All levels are extremely difficult, and in order to successfully complete your mission you must conquer the Centaurs and penetrate the vault on each successive level. Vault of the Centaurs is fast paced and visually very effective. A cardboard overlay is included in the package which puts the six cursor keys at your fingertips, while covering up the other keys. If you fancy yourself to be Jedi material, then Vault of the Centaurs is a game you don't want to miss. ★★★

For more information, circle 9 on reader service card.

Lightning Tour

80 HOURS AROUND EUROPE

International Publishing & Software, 16 K

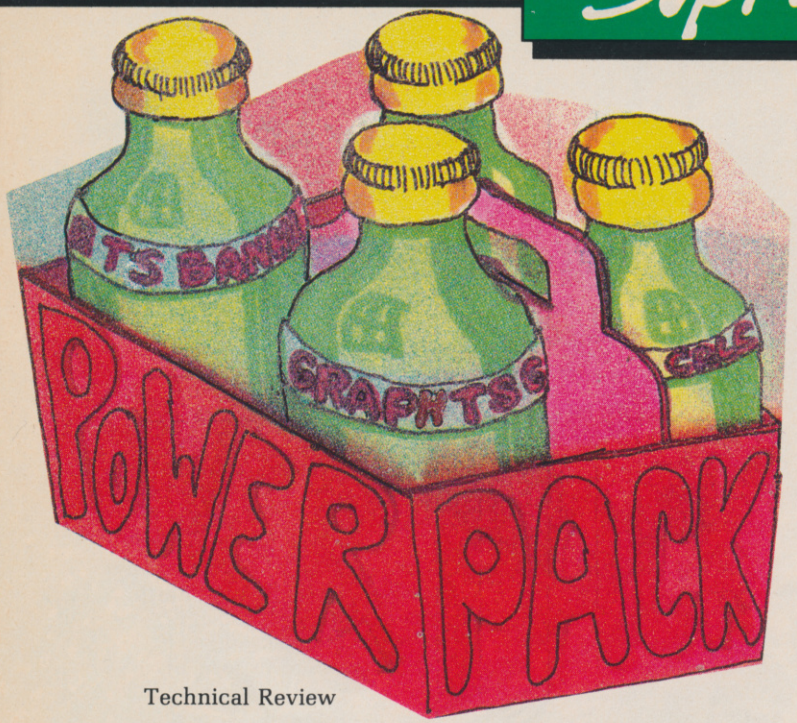
A refreshing change from space games is 80 Hours Around Europe, which takes you on a whirlwind tour right here on Earth.

The object is to visit 12 European cities in 80 hours with 1,500 British pounds. Sound easy? Well, it's not. You must obtain a souvenir from each city before you can travel to the next. Getting there is tricky for there are all sorts of unpredictable delays, including losing money in poker games, snow drifts, having to bribe officials, having to return to the last city in order to retrieve a forgotten souvenir.

Upon arrival in each city you must convert a portion of your British pounds into the local currency, then purchase a souvenir as well as transportation to the next city. But buyer beware because the price for souvenirs can fluctuate, which can devastate your budget. There's no time for sightseeing in this game because the clock ticks away the hours as you conduct your business. The game is self-explanatory, loads easily, and is lots of fun. ★★★

For more information, circle 10 on reader service card.

— Reviews by ***George Miller, Gary Walker*** *and* ***M. K. Wilson.***



Technical Review

Mixed-Use 4-Pack is a Mixed Blessing

POWERPACK 1

Timex, 2K

Powerpack 1 contains four programs. The first, TS CALC is designed to be a powerful calculating aid with ten memory locations, and full mathematical and trigonometric function capability. The next, TS BAR draws elaborate bar graphs of up to 12 quantities. TS GRAPH charts polynomials and TS BANNER provides a repeating moving headline on a marquee centered on your monitor.

Although all four programs loaded beautifully, TS CALC would not run even the suggestion contained in the printed instructions. TS BAR drew a nice set of bar graphs and the largest quantity filled the screen with smaller quantities being relatively shorter. TS GRAPH reflected the shortcomings of the graphics mode: it worked, but the graph was not smooth — a fault not of the program — but of the machine. TS BANNER accepted a lengthy message (97 characters) and flashed it repeatedly across the screen in a graphics marquee. Though the instructions said to enter a "new message, press BREAK, then CONT," all that did for me was eliminate the marquee: the message continued. I had to restart the program to change messages.

Other available programs accomplish the aims of these programs with greater elegance. However, Powerpack 1 does it for a 2K RAM. Though TS CALC did not work for me, I found TS BAR and TS GRAPH satisfactory and TS BANNER good.

Overall, Powerpack 1 is a useful product. I'm sure TS CALC (if working) could be useful in some specialized way. TS BAR produces fine bar graphs, and TS GRAPH plots algebraic expressions satisfactorily — something I've wished for every day since high school! TS BANNER does its job well. ★★

For more information, circle 11 on reader service card.

Previously Reviewed

All tapes are 16K unless otherwise noted.

Chessmaster — **Chess**. Allows you to save unfinished games for later, change sides, resign, and choose one of seven levels of difficulty. Of all chess programs, our reviewer gave this one top marks. ★★★★

Intercomputer — **Demolisher**. Drop bombs on an increasing mass of blocks beneath you. Our reviewer called this game a sleeper. ★½

Intercomputer — **Missile Launcher**. Target practise. This slow, simple game does not make good use of its 16K, and allows you to participate only in the firing of missiles. ★½

International Computers — **Galactic Invasion**. Choosing the velocities of your 15 rockets also determines their directions; you fire them to save Earth from invaders. Also on the tape are three action games, a solitaire and a drawing program. None are very fast or really engaging. ★½

International Publishing & Software — **Flashcard**. In the classroom, a flashcard has a problem on one side and an answer on the other. This program lets you input the problems and answers, poses questions at random, and gives a score at the end. ★★★

International Publishing & Software — **Galactic Invaders**. Seven alien ships fly over your laser base; when you destroy them, the next regiment appears. You get to choose the speed. Annoyingly, some of the aliens take long rests on the ground, but the game is still a must for the video game connoisseur. ★★★

International Publishing & Software — **Home Money Manager**. Lets you keep track of your finances on a monthly basis, then do a month-by-month or full year balance sheet. Well-documented, well-conceived, user-friendly. ★★★½

International Publishing & Software — **1K Chess**. Limited-option game suitable for beginners on an unexpanded ZX81. Does not allow castling or en passant moves. ★★

International Publishing & Software — **Packrabbit**. Fast-action maze game with a choice of six mazes. You are a rabbit chased through a carrotpatch by four hunters, and must eat carrots to gain points. When you eat one of the magical carrots, the hunters become edible. (Note: for a limited time, all new subscribers to TSU will receive this game as a subscription bonus.) ★★★½

International Publishing & Software — **2K Chess.** Allows castling and en passant moves but will not let you change sides, resign, or save a game for later. Suitable for intermediate players using an unexpanded T/S1000. ★★½

International Publishing & Software — **ZX Assembler**. Occupies 7K at the top of the memory. Programming in machine language is much more difficult than in BASIC, but programs such as this offer aid by allowing you to enter and edit machine language using mnemonics. With the clear, detailed, 26-page manual and a good book on Z80 machine language, a beginner will find this program easy to use. ★★★½

International Publishing & Software — **ZX Scramble**. Hit enemy installations before they hit you, while maneuvering to avoid crashing into treacherous terrain. The game is slow, and the terrain repeats itself like a chase scene in a poorly animated cartoon. ★★

Melbourne House — **Combat Flight**. Fly through mountainous terrain and shoot at alien ships. An unexceptional invaders-type game. ★★

Melbourne House — **3D Monster Maze**. Evade Tyrannosaurus Rex in a huge, realistic maze — not too difficult, since Rex is a touch sluggish, which tends to slow what should be a fast, exciting race. ★★

Melbourne House — **3D-Orbiter**. As they approach, the alien ships grow and display increasingly fine detail; when you shoot them, they explode with wonderful realism. Besides the superb visuals, this game is very exciting and will provide hours of fun. ★★★★

Mindware — **Cosmos**. Avoid hitting your own convoy and alien space mines as you fly through space looking for alien ships to destroy. Fast, fun and challenging. ★★★

Mindware — **The Fast One**. A "computerized filing cabinet," ideal for setting up lists of phone numbers, recipes, addresses, inventories, and any other listable information. Excellent documentation. ★★★½

Mindware — **Gulp**. You move around any of six mazes at any of nine

Software

speeds eating dots while a hunter pursues you. The keys that control movement are too close together, and after you eat the last dot you have to be captured before the game ends, but it's still enjoyable. ★★★

Mindware — **Labyrinth**. You may choose to see an overview of the complex, 3D-style maze before you wander through it, and if you get lost and give up you get to see the whole picture again. With practise, the trek becomes simpler. An interesting game but not a classic. ★★½

Mindware — **Multiple Choice**. This so-called "educational" program asks questions like "What is the capital of New York state?" and "What is the square root of 2?" but isn't really anything more than an information drill. As such it works well, though, and lets you create tests of your own. ★★★

Mindware — **Pilot**. Land a small aircraft using 12 keys to control direction, flap and landing gear, and speed of climb and descent. Realistic cockpit meters display air speed, altitude, fuel, distance to the runway, and so on. Landing is difficult but you can always switch to automatic pilot. ★★½

Orbyte Software — **Home Budget**. Its 39 categories (which you can alter) help you organize your spending habits. After analyzing proposed and real budgets, this program compares them in graph form; and despite poor documentation, does a good job. ★★★

Orbyte Software — **Mega Mind**. Addictive game similar to Mastermind, using shapes instead of numbers. Guess what shape is where: the computer tells you the number of shapes in the right and wrong position, leaving you to shift them. Five levels of difficulty. ★★★

Quicksilva — **Munchees**. From one to four ghosts (you get to choose) chase you around a well-constructed maze. The movement keys are too close together, causing difficulty at high speeds, but this game is still fun to play — repeatedly. ★★★

Reston Publishing — **Invasion Force**. Shoot lasers through a moving force field to destroy alien ships, and watch out for bombs. The game is fun, the graphics distinctive. ★★★½

Reston Publishing — **Math Series**. This full-fledged math program is divided into six sets corresponding to grades one to six, each with 32 lessons, a 64-page workbook, a vinyl storage case, and a hefty pricetag. ★★★½

SoftSync — **Computer Tutor**. This series includes Math Raiders and Alpha/Vowel Tutor, which really don't teach, but rather ask questions and correct wrong answers. For fun, it rates high; for educational value, it rates low. ★★½

SoftSync — **The Financial Manager and Record Keeper**. This well-designed program has 19 categories to help you keep track of your dollars–tells you what per cent of your income each of your expenses constitutes, and makes other sundry financial calculations. A good budget planner. ★★★

Softsync — **Graphics Kit**. Offers 23 machine language routines and a variety of sophisticated graphics devices like REVERSE and BORDER. If every Timex retailer used this as a demonstrator, sales would soar. Documentation poor. ★★★

SoftSync — **Night Gunner**. You are the pilot of an airplane in an aerial dogfight with four others, and must shoot them down before they shoot you. The game is fun, the action fast, the graphics not outstanding. ★★½

SoftSync — **Starblaster**. One of a six-pack of 2K games marred by poor instructions but enjoyable for those who own machines with unexpanded memories. ★★

SoftSync — **TS Destroyer and Space Raid**. Fast action duo in 2K. In TS Destroyer, you must dodge or destroy floating objects as a spaceship takes potshots at you; in Space Raid, you must shoot a hole through a spaceship and hit the left foot of an alien. Neither game prints a score. ★★★½

SoftSync — **Superchess**. Plays a mean game at ten different levels of difficulty. Recommends moves, plays itself, but doesn't let you save games for later. Packaging adequate but not great. ★★★½

Thomas B. Woods — **ZX Data Finder**. This storage and retrieval system offers some very advanced title and word search features, and helps you keep track of everything from correspondence to car repairs. Comes with a complete listing and a thorough explanation. ★★★★

Timeware — **Chess**. Offers six levels of play, recommends moves, allows you to save unfinished games for later but not to resign. ★★★

Timex — **Ator, the ABC Gator**. Eye-catching graphics, great pacing, and sound make this educational tape of great value to children just learning their ABCs. An adult is needed to synchronize the sound with the visuals and to help the youngster read the instructions. ★★★½

Timex — **Chess**. Doesn't recommend moves, play itself, change sides or allow you to save or print games. Offers six levels of difficulty. ★★★

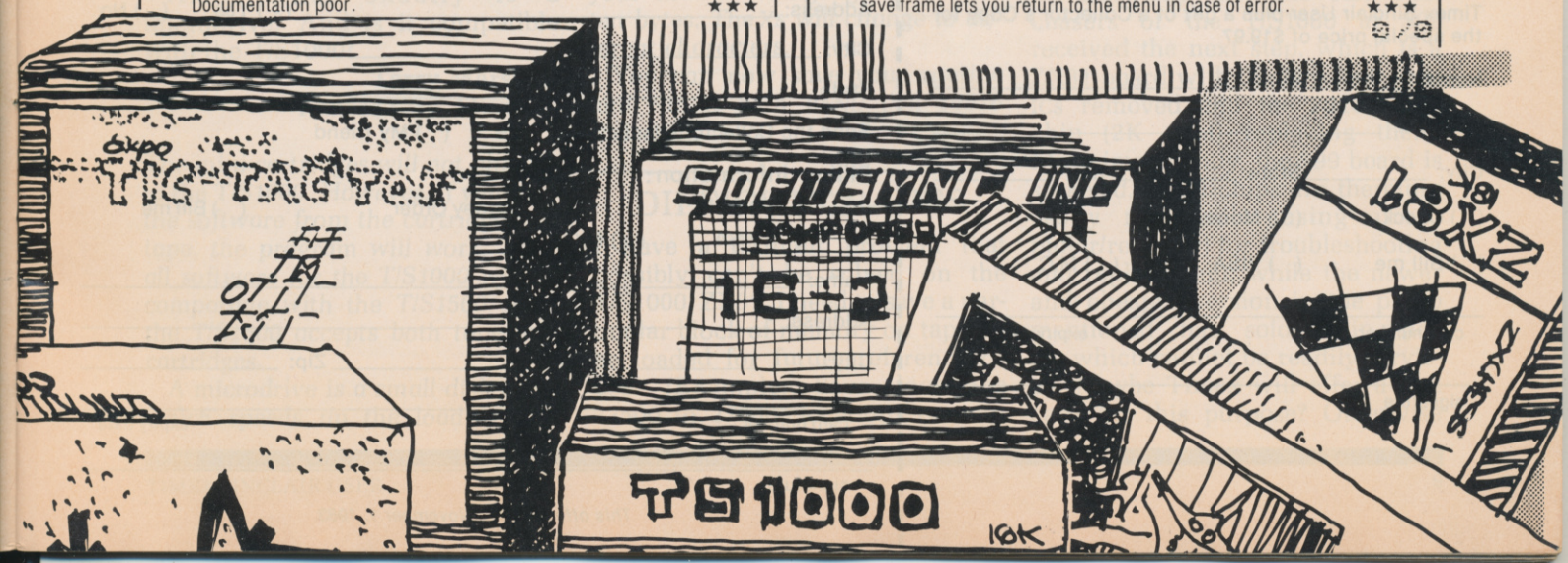
Timex — **The Coupon Manager**. Before you go shopping, you can flip through your file of coupons and pick out the ones you need. Keeps track of amount, store and expiry date. A must for the compulsively organized. ★★★

Timex — **The Cube Game**. A computerized variation of Rubik's Cube. Choose a solid, unfolded two-dimensional or see-through three-dimensional cube, then move blocks by specifying axes. The movements are slow, the graphics good — once you get used to them. ★★

Timex — **Flight Simulation**. Land your plane successfully on the runway, taking flying speed, wind speed, altitude, fuel and other variables into account. You win by not crashing. ★★★★

Timex — **Mixed Game Bag 1**. Bowling gives you ten frames of 10-pin; you control the ball's direction with the up and down arrows. Bingo gives you a card, a series of random numbers, and the opportunity to cheat by not verifying your claim of Bingo. Robot Wars is a humorously visual version of Mastermind, and the best game in this well-rounded package. ★★★

ZX-Panding — **Checkbook, Tax and Budget Organizer**. Helps you manage your finances. Comes with a clear, four-page booklet but gives no clear instructions on how to get going after loading. An excellent save frame lets you return to the menu in case of error. ★★★



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This offer expires November 1, 1983.

Letters

TWO QUESTIONS

Can you answer these questions for me please?

(1) What is the largest number the ZX81 stores as an integer?

(2) I would like to use my ZX81 as a remote terminal to connect with a mainframe but the mainframe requires a @ before all system commands and the ZX81 does not have a @. Is there any way around this problem?

Ronny Richardson
Chamblee, Georgia

The ZX81 stores integers as eight significant figures (four bytes) and a one byte exponent + 38, ie. 9999999 or 9.9999999 + 38.

About the @ — it is 4OH ASCII which is 64 in the decimal system. All your data would have to be converted into ASCII since this is the language most mainframes use. A short machine code program could do this. You could do it in BASIC but it would be very slow. In your machine code program you would redefine the keyboard and then establish a link with the mainframe by developing a new set of control characters. If you need some more information, just write to us again. Good luck with your link!

COMPATIBILITY

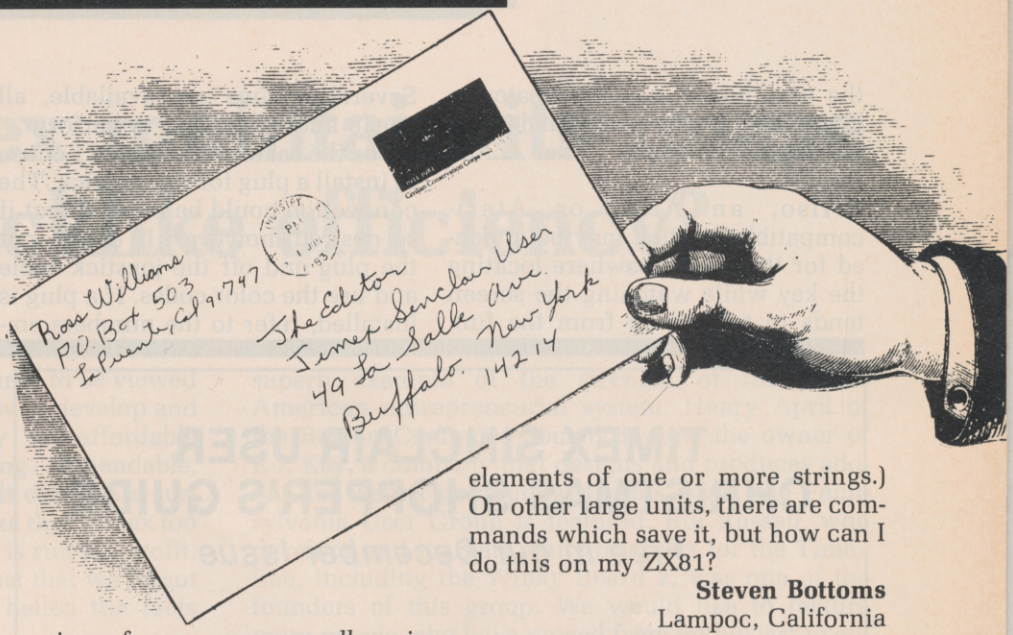
Will the solid-state mini-cartridges and interface for the T/S1500 be compatible with the T/S1000?

Also, what exactly is a microdrive? And is it compatible with the T/S1000?

Terry Marshall
Kansas City, Missouri

The mini-cartridges will not plug into the T/S1000. However, if you save the software from the cartridge to a tape, the program will work. Also, all software for the T/S1000 will be compatible with the T/S1500 since the T/S1500 accepts both tape and cartridges.

A microdrive is a small disk drive which speeds up the loading and saving of programs as well as increasing reliability. You should check with the manufacturer regarding its compatibility with the T/S1000.



REMARKABLE

How do I save specific bytes of memory?

John Schmitt
Aylmer, Ontario, Canada

The best way to save machine language is to store it in a REM statement at the beginning of a program. For example, if your routine is ten bytes long, make your first statement:

1 REM XXXXXXXXXX

The ten Xs will reserve ten bytes starting at address 16516. Now poke your machine language into these ten bytes. The Xs will change to different characters.

You can now save your routine and run it with RAND USR 16516 statement.

DIFFICULT SAVES

I have a difficult problem that possibly can't be solved on the T/S1000, ZX81. I need to save a particular block of memory on tape, to be loaded for future reference or use. (Example: Save locations 22500 to 27600; locations contain elements of one or more strings.) On other large units, there are commands which save it, but how can I do this on my ZX81?

Steven Bottoms
Lampoc, California

The save always starts at the beginning of the BASIC area. There is no easy way to save a particular block of memory unless the block starts at the beginning of BASIC. Some special pieces of software have been developed to help with this problem.

TECHNICAL NOTE

Regarding your *In-Depth* article of issue No. 1, "Inside the T/S1000, ZX81," it is worth mentioning that the photo on page 43 is not necessarily what a T/S1000, ZX81 owner will find upon opening up his or her computer. The ZX81 is a five chip board with RAM locations 4a and 4b, so there will be two smaller chips at the right, and the CPU is nearest to them, followed by the ROM and then the ULA. Purchasers of the T/S1000 at $99 received the next step, which is a ZX81 board with the two RAM area ICs removed and the 2016 static chip (2K RAM) replacing them. More importantly, the $99 board is *socketed*, so all chips are therefore easily removable (using an IC puller/replacer) for troubleshooting and replacement, while the newer and cheaper version in the photo mentioned has soldered-in-place ICs which cannot be readily serviced. Maybe Timex will offer a CPU card for this purpose? Otherwise

Letters

the new board is much neater in layout and more professional in appearance than the older ZX81 boards.

Also, an Atari or Atari-compatible joystick may be attached for those games where locating the key while watching the screen tends to take away from the fun. Several options are available, all cheap and fairly easy to perform.

For the sake of being neat I chose to install a plug for the joystick. The connection could be made direct if so desired, however. If direct, cut the plug end off the joystick cable and use the color codes. If a plug is installed, refer to the numbers embossed on the plug or to the diagram. To use keys 5-6-7-8 as up-down-right-left is not possible with this method, however 6-7-8-9-0 is; and turns out to be a good alternative. 6, 7 and 8 are used for the same directions as indicated by the arrows on the keyboard; 9 is substituted for 5; and 0 is used for fire control.

Connections to Sinclair KB ports:

DE9P No.	Color Code	Keyboard connector
8	Black	8
2	Blue	1
1	White	2
4	Brown	3
3	Green	4
6	Orange	5

Using the joystick has the same result as if the related key were depressed; so the software requires writing for keys "6", "7", "8", "9", "0". As an example, in the Laser Cannon listing in issue Number 2, change line 130 from IF INKEY$="8" to IF INKEY$="0"... and line 140 from IF INKEY$>"5"... to IF INKEY$>="0"... and line 190 change "8" to "0". This enables key 0 as fire control so movement and fire is the same as an Atari (control). The drawback is that machine code programs such as Flight Simulator are not as easily changed (it requires substituting the 9 key for the 5 key in machine code instructions).

The DE9P costs under $2 and the Atari joysticks range from $7 to $25 dependent upon manufacture and model. I used the controller that came with my VCS (2600) and it works just fine.

Ed Pardo
Hopatcong, N.J.

TAPE RECORDER BLUES

I will be more than happy to subscribe to your magazine if you can find a tape recorder that will LOAD. If you can get me a tape player that is guaranteed to work, I will even buy it from you.

Carlin S. Champlin
Brockport, Pennsylvania

Carlin, we're both in luck. We get you to subscribe and you get to use a

continued on page 46

TIMEX SINCLAIR USER CHRISTMAS SHOPPER'S GUIDE

Free in our December Issue

The December issue of Timex Sinclair User magazine will feature a Christmas Shopper's Guide as a special "pull-out" section. This mini-magazine within a magazine will help you with your Christmas shopping. A gift for every T/S user on your list.

FEATURES:

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Can Timex maintain its image of clocklike efficiency?

OVER THE YEARS, Timex came to be viewed as a company that knew how to develop and market modern technology at affordable prices. We saw a smooth-running, dependable, always-come-up-ticking operation. It came as a surprise — no, a shock — for us to realize that Timex too is fallible. It is run by people and it is run for profit. Neither of these things is bad, it's just that we forgot them. Timex's clock-like business belied the facts beneath the organization.

As in all organizations that are on top for so long, small mistakes can be glossed over. The corporation can absorb many knocks, especially those delivered from within by well-meaning executives. No one decision, no one person, no one step suddenly causes the giant to falter, but a series of mis-

judgments, unavoidable problems and technical difficulties seem to come together at one juncture. Timex Computer Corporation appeared at one of those junctures. That the company and the computer weathered the crossroads is solid testimony to the health of both. Still, we at *Timex Sinclair User*, who wish nothing but health and success for Timex, feel the company should take a collective breath, regain its cool and take up where it left off . . . at the top! Build on its past success formula: modern technology at consumer price levels.

The new T/S1500 and T/S2068 are excellent machines. So much so that there is talk in the U.K. of importing them (the parent outstripped by its offspring). We hope that Timex presents these machines in a light that allows the public to see just how great they are.

Timex is a strong company! The T/S1500 and T/S2068 are strong computers! Let's have a show of strength from Timex Computer Corporation!

Inside this month

Many early enthusiasts of the T/S1000,ZX81 set up active and exciting user groups. From these groups have emerged many small companies. This is a superb example of the strength of the North American entrepreneurial system. Henry April of the Boston Computer Society is now the owner of E-Z Key, a company that designs and produces add-ons for Timex computers. In this issue, the Pennsylvania User Group is featured. Bill Russell, who develops and markets many products for the Timex line, including the Winky Board 2, was one of the founders of this group. We would like to feature more people who have moved from enthusiast to entrepreneur. Write to us about your experiences or those of someone you know.

Color on your T/S1000,1500,ZX81? Yes sir! Our feature project this month shows you how to build just such a colorboard. You can use this device to generate color from your black and white computer. Of course, you will need a color television, but as the saying goes, in order to see through rose-colored glasses, you need to have rose-colored lenses!

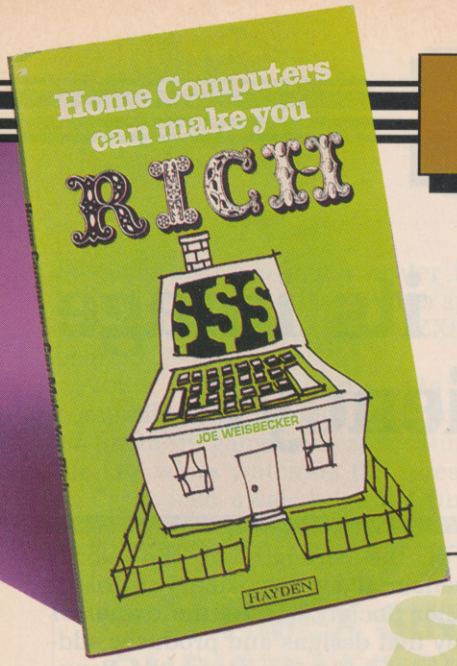
Our Kingdom For A Subroutine

Astute readers will remember that one of our *Program Printouts* this month, Kingdom, ran, minus about a dozen lines, in Issue #3. Numerous readers told us of the problem. "You blew it last issue!" wrote Mike Potter of Frankfort, Illinois. "Kingdom looks like it could be a very good game if I could figure it out," said Robert Keneely of Kew Gardens, New York. David A. Hartmann of St. Ann, Missouri told us: "It was very ironic that the same issue you did a story on 'Software Blues' . . . My compliments to Andrew Johnson for an otherwise fine program." Kingdom *is* a fine program, Andrew, and we apologize to you and our readers for botching it. It's worth another try.

As John Gilbert's five part series on programming ends, we are excited to introduce a new series, Programming Arcade Games. This set of articles is taken from the yet-to-be-released book of the same name from Reston Publishing of Reston, Virginia. In this series, our own Bob Fraser (programmer turned author) leads on from where Gilbert left off to show you special ways to get arcade-like games from your computer.

All in all, a special issue! As usual, if you have any special thoughts or ideas, programs or print-outs, kudos or complaints, let us hear them.

• *Write to* Timex Sinclair User, *49 La Salle Avenue, Buffalo, N.Y. 14214-1414.*



Capital Ideas

Home Computers Can Make You Rich, *by Joe Weisbecker*
(Hayden, $7.95)

WEISBECKER'S BOOK is full of ideas on how to turn your spare time and your interest in computers into dollars. You don't have to own a computer to appreciate this book, or like computers, but it helps.

Home Computers Can Make You Rich gives us a very short course in business procedures, in which such topics as money-making principles, trend-watching, and possible pitfalls are discussed. Weisbecker encourages us to make money "for fun and profit" in our spare time and assures us that it is "easy to do." We are introduced to our potential customers: "hardware-hackers" (those who play with circuit boards, electronic gadgets, design and build kits, and so on),

> Turn your bits and bytes into dollars and cents

technicians, engineers, repairpersons, and other computer enthusiasts.

This is essentially an 'idea' book. There are many interesting ideas presented that could be developed into a supplementary income, but these would prove financially worthwhile only after much careful thought and planning. Weisbecker makes his money-making ideas seem easy, and downplays the time, skill, and business acumen required to commit his (or your) ideas to reality and actually have them pay off. His message is clearly optimistic: "You can do it."

Among the potential money-making ideas presented are writing articles for various publications, writing a newsletter, writing a book, creating and selling programs, becoming a computer consultant or repairperson, or renting out computers by the day or week. There are some novel ideas too, such as using your computer to entertain at parties; for childrens' parties, you'll also need a funny hat and costume.

Available from Hayden, *Home Computers Can Make You Rich* may well be the motivational boost you need to get your ideas off the ground and start turning your bits and bytes into dollars and cents.

— M.K. Wilson

The Microchip Demystified

Mastering Machine Code On Your Timex/Sinclair
by Toni Baker
(Reston, $18.95)

BASIC is a good language. In fact, it's more than adequate for most applications, especially if you're new to programming. But where does one turn to satisfy the cravings for mega-fast number crunching or lightning-quick graphics? The answer lies in machine language programming.

Toni Baker's *Mastering Machine Code on Your Timex/Sinclair* is in essence a step-by-step tutorial on how the Z80 microchip works. Machine code is the Timex's native language, while BASIC is a bilingual guide. Learning machine code eliminates this need for translation and the time it takes. The result is a computer program that runs more efficiently and, therefore, faster.

One of the first chapters clears the air about computers and their hexadecimal number systems. For instance, did you know that the T/S1000, ZX81 and all other personal computers use a base-16 number system? Baker tells how to make the transition from our more commonly used base ten to hexadecimal and back again.

The other chapters are filled with hands-on programming applications: the reader learns by doing. Imagine experimenting with graphics and music mixed in with your game creations. Yes, music from the Timex! Baker ignored the systems design and went on to figure a way to make music using machine code.

Programs include: Graffitti, Draughts (Checkers), Spirals and other games. Especially useful are the De-bugging and Dis-Assembler utilities. This text is must reading for anyone wanting to learn to fine tune their programs.

— Tim Banse

Disassembly book is complex, invaluable

The Complete Timex TS1000/Sinclair ZX81 ROM Disassembly, Parts A & B, *by Dr. Ian Logan and Dr. Frank O'Hara (Melbourne House, $19.95)*

WHEN Dr. Logan says complete, he means it. This compilation of two volumes (previously sold separately) provides the serious machine code programmer with an annotated disassembly of the monitor program from one end to the other. The first part, up to memory address OF54 (hex), does not have line by line comments as does the second, possibly due to O'Hara's influence. Though these comments would have been nice in the first part, they are not essential, since the subroutines are generally less complex than those in the second, which deal mainly with floating point mathematical operations.

Both sections, however, have simplified flow-charts and break down the program into individual subroutines that are titled and indexed by the authors. All entries and exits are labeled as well as addressed in hexadecimal. Tables are also included with indicators and comments when necessary. The appendix contains five short BASIC programs that illustrate how SIN, EXP, LN and ATN functions work in the monitor using Chebyshnev polynomials. This might all sound a bit complicated to the beginner, and rightly so, since the book is no piece of cake for advanced programmers either.

The complexity does not come from Logan (who has done an amazing job), but from the original programmers who crammed the program into eight kilobytes of ROM, unconcerned about its readability. As O'Hara indicates at the beginning of Section 2, the feat is doubly amazing considering that Logan did not consult with the Sinclair organization to decode the program. It seems that he reads assembly language like we read magazine articles.

This book is in a class of its own. Many volumes deal with the Z80 microprocessor and assembly language in general, and several relate these directly to the T/S1000,ZX81, sometimes supplying machine code and assembly routines of questionable quality and usability. Books specifically devoted to your computer are usually the most helpful, since you can apply the information concretely. Drs. Logan's and O'Hara's work provides hundreds of proven subroutines that you may access directly, recopy and alter in RAM, or simply learn from.

If this book seems difficult to assimilate, it's because there's so much to learn from it. If you are a beginner and serious about machine language programming, don't wait until you are advanced to get this disassembly; you may wait a long time. Since you'll have to learn assembly sooner or later, why not start with the original program in the Sinclair ROM? ☺/☺

— André Roussil

> Amazingly, in decoding the monitor program, Logan did not consult with the Sinclair organization

Inventor Jim Stephens shows how to build a colorboard for only $62

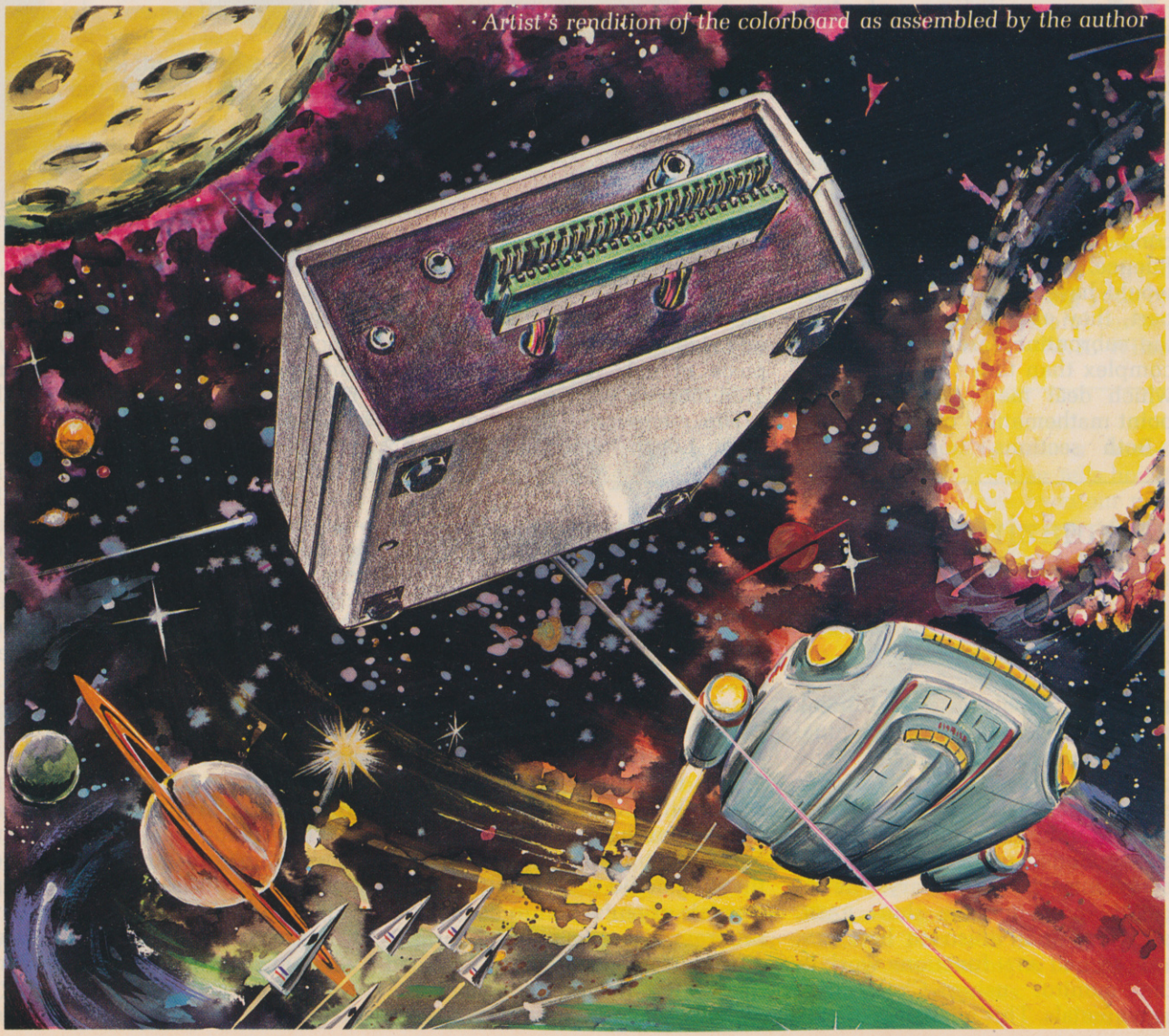
Convert your T/S,ZX to Color

OKAY, so I'll admit my little ZX81 has a few shortcomings. Some of these I can live with. Some I had to change.

My computer games were constantly being criticized by my two sons, who reminded me daily that so-and-so's computer had color games. Well, I added color to my T/S1500,1000,ZX81 and got four extra pages of memory in the process. Let's see old so-and-so top that.

Now my games have an extra tint of realism, my charts are clearer and my neighbor is somewhat less smug.

The colorboard is not a simple project and should be undertaken only by persons with a lot of patience and experience in kit-



Artist's rendition of the colorboard as assembled by the author

ILLUSTRATION • Don Kletke

building. The builder should understand that there are a few limitations, and the use of the board is sometimes awkward unless sophisticated software is written to handle the board's operation. The project is presented mainly as a learning experience, and proper operation will ensure an increased knowledge of computer electronics and how data is manipulated and used for purposes other than number crunching.

How the Colorboard Operates

The T/S,ZX colorboard is built around a super chip called the MC6847 Video Display Generator (VDG) and its companion chip, the MC1372 Color Modulator. Don't let these fancy names scare you. These chips are readily available through most parts supply houses or can be ordered from Motorola. Many of the mail order suppliers also stock these. The 6847 is a 40-pin MOS chip that has the ability to display a 64 element ASCII character set, up to 256 x 192 graphic pixels and eight

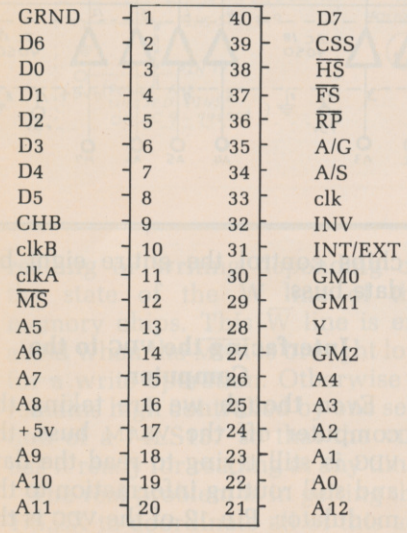
Warning: the colorboard is not a simple project, and requires patience and experience

colors. The high resolution, however, requires 6K of memory so I limited my matrix to 128 x 64 using only 1K of video RAM (VRAM). The connections in Figure 1 show how the wide range of modes are handled by the various connections. For example, if the board is wired as in Figure 2, a data word of 1000 0010 or 130 decimal would produce a color quarter pixel in green. Changing the data bits in the word changes either the alphanumeric character, color or shape of the pixel. Figure 3 shows the decimal numbers for each of the alphanumeric characters and graphic shapes. The colors are changed depending on the value of the three most significant bits in the word. If a higher resolution is desired, and only graphics are needed, then a resolution of 128 x 64 can be obtained by wiring the mode select lines as shown by line eight of Figure 1.

As you can see, the various modes and capabilities of the 6847 can be readily handled by software. With the use of machine code, a great game of super breakout can be achieved, and in color!

Video Circuit Operation

The block diagram in Figure 4 will give you an idea of the various data paths and how information is routed to produce the display. The VDG constantly scans the 1K of VRAM with its address lines and samples each location and reads the stored data. This information is read into the VDG and is output as raw video to the 1372 color modulator. The 1372 circuit impresses the video data onto its RF output which is then fed directly to the television antenna terminals. The video signal from the T/S,ZX is

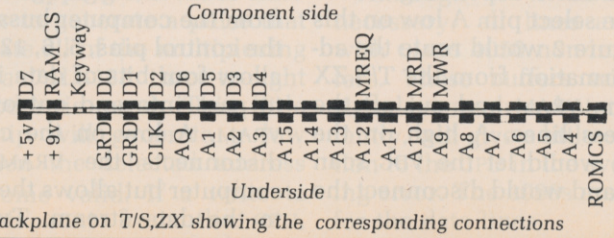

GRND 1 40 D7
D6 2 39 CSS
D0 3 38 $\overline{HS}$
D1 4 37 $\overline{FS}$
D2 5 36 $\overline{RP}$
D3 6 35 A/G
D4 7 34 A/S
D5 8 33 clk
CHB 9 32 INV
clkB 10 31 INT/EXT
clkA 11 30 GM0
$\overline{MS}$ 12 29 GM1
A5 13 28 Y
A6 14 27 GM2
A7 15 26 A4
A8 16 25 A3
+5v 17 24 A2
A9 18 23 A1
A10 19 22 A0
A11 20 21 A12

MC6847 Pin Locations-Top View

Mode Selection of the 6847 VDG *

VDG pins							output of VDG	required memory
A/G	A/S	INT/-EXT	INV	GM2	GM1	GM0		
-	-	-	x	x	x	x	64 ASCII Characters	1/2K
-	-	-	+	x	x	x	same but inverted	1/2K
-	-	+	-	x	x	x	external ROM capability	1/2K
-	-	+	+	x	x	x	same but inverted	1/2K
-	+	-	x	x	x	x	8 colors-Alpha/graphics(64x32)	1/2K
-	+	+	x	x	x	x	4 colors-Alpha/graphics(68x48)	1/2K
+	x	x	x	-	-	-	4 color graphics (64x64)	1K
+	x	x	x	-	-	+	2 color graphics (128x64)	1K
+	x	x	x	-	+	-	4 color graphics (128x64)	2K
+	x	x	x	-	+	+	2 color graphics (128x96)	2K
+	x	x	x	+	-	-	4 color graphics (128x96)	3K
+	x	x	x	+	-	+	2 color graphics (128x192)	3K
+	x	x	x	+	+	-	4 color graphics (128x192)	6K
+	x	x	x	+	+	+	2 color graphics (256x192)	6K

Note: (-) = ground, (+) = 5 volts and (x) = don't care
Source: Specification sheet no. ADI-492 R2 Motorola Semiconductors, Austin, Texas.



Pinout of backplane on T/S,ZX showing the corresponding connections

Figure 1

obtained as shown in Figure 5, which provides the T/S,ZX data to the newly constructed modulator. If a color video monitor is used (an expensive item), the 1372 circuit can be eliminated entirely.

The video circuit is basically a stand-alone system which continuously outputs color data to the screen. The problem occurs when the data in the VRAM has to be changed. If the constantly changing address and data lines of the VDG were put directly on the buss of the T/S1500,1000,ZX81, complete havoc would result. A method must be devised to shut off the VDG, open the buss to the computer, read or write into the 1K, and then disconnect the buss in order for the VDG to continue its operation. All of this must be done quickly and orderly to avoid screen flicker. It is not an easy task, but much simpler than you would think.

The Interface

Of all the exotic interfacing chips, two of the most simple are the 74LS157 Quad2-Line to 1-Line Data Selector/Multiplexer and the CMOS 4066 Quad Bilateral Switch. These long names simply mean that they are electronic switches that connect and disconnect the buss lines at the proper time. This procedure is called "multiplexing." Since there are two different busses with different characteristics, two types of multiplexing will be necessary for proper operation.

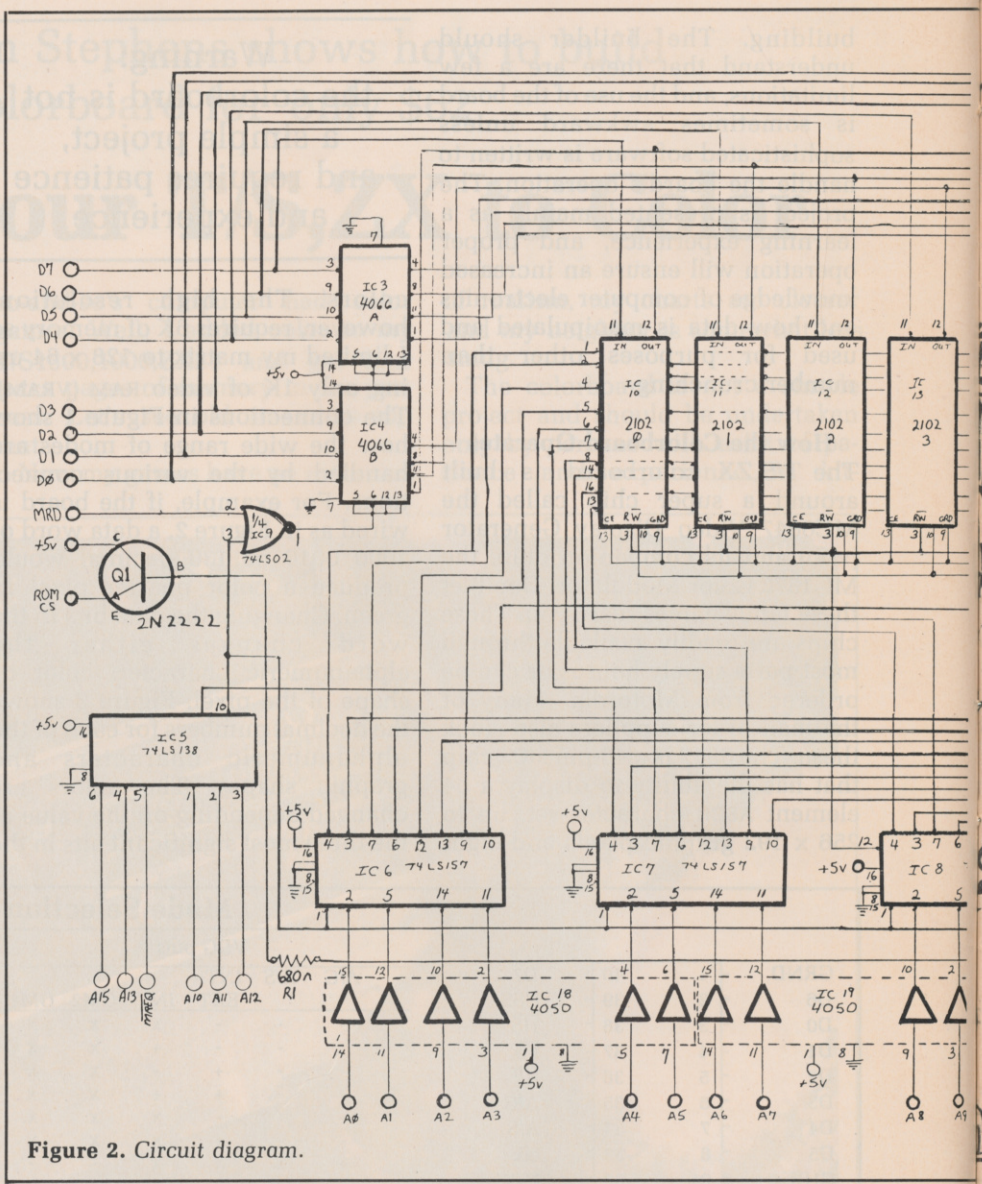


Figure 2. *Circuit diagram.*

Address Multiplexing

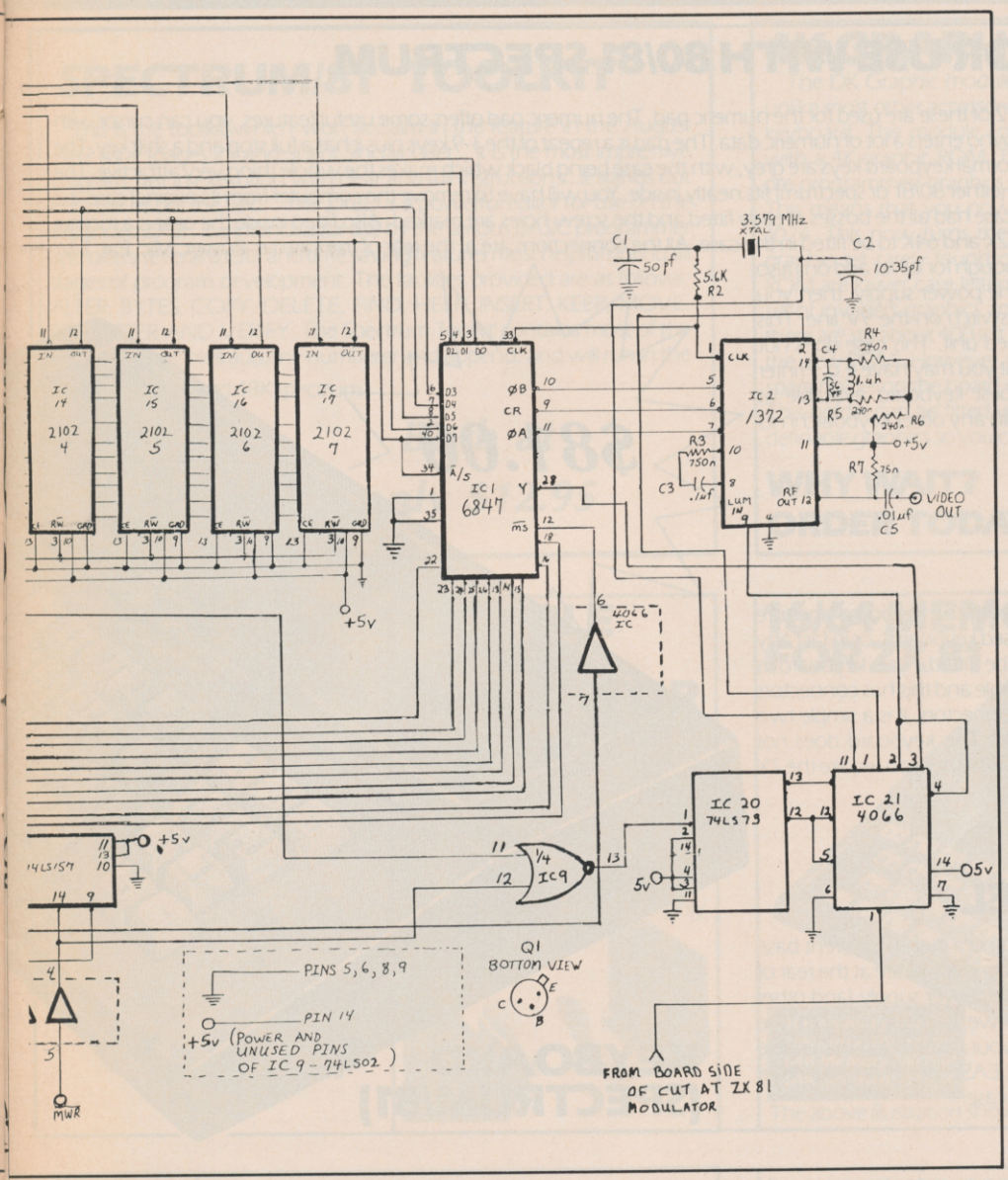
The address buss accepts its data in only one direction. That is, the direction of flow is always *to* the device, never *from* it. The 74LS157 accepts two inputs from two different sources and outputs either one or the other depending on the state of the select pin. A low on this pin in Figure 2 would route the address information from the T/S,ZX buss to the VRAM and cut off the VDG address lines. A high on the select pin would let the VDG scan the VRAM and would disconnect the T/S,ZX.

Data Multiplexing

Since the data buss transfers data information in two directions, the CMOS 4066 analog switch was chosen. This 14-pin chip contains four separate line switches which effectively connect and disconnect the data lines going to the VRAM from the computer buss. A high on the control pins, 5, 6, 12 and 13 will allow four bits of data information to pass into and out of the 1K of VRAM. A low on the control pins disconnects the VRAM from the computer but allows the VDG access to the data stream. Two of these chips control the entire eight bit data buss.

Interfacing the VDG to the Computer

Even though we are taking the computer off the VRAM buss, the VDG is still trying to read the data and still routing information to the modulator. Pin 12 of the VDG is the chip select pin that shuts down the 6847 when that pin is brought to a low state. The $\overline{CE}$ pins of the eight 2102 RAM chips are permanently enabled by being wired directly to ground. Therefore, they are either



reading or writing depending on the state of the W line of the memory chips. This $\overline{W}$ line is enabled when the $\overline{MWR}$ is brought low for a write operation. Otherwise it remains high controlled by one section of a 74LS157 so that the VDG has it ready for reading at any time.

The real problem is in getting the T/S,ZX to coordinate all of this activity in a usable fashion. The Z80 CPU has several methods to accomplish this. There are two major ways in which the Z80 accesses memory or any external device. One is called the I/O Port Method where the device select number is generated by the eight low address lines. Our method is the memory map technique. This method is much simpler since we are basically using RAM as the external device.

Memory Mapping the Video RAM

In order to generate a pulse that will activate all of the multiplexing circuits, a 74LS138 three-to-eight line decoder is used. This little 16-pin chip will generate a low pulse when the selected address lines become valid. If a write to memory is sent from the CPU, several things happen on the buss that give us the signals to control the address and data switches. First the CPU puts the address information on the buss in response to a write command. Then, the $\overline{MREQ}$ line goes low. The $\overline{MWR}$ goes low and the $\overline{MRD}$ remains high. The proper use of the signals along with the address lines enable us to control the multiplexers in a coordinated fashion. This is called interfacing.

The 74LS138 has three chip enable pins and three data pins. A high on pin four or five or a low on pin six will disable the chip. Since the address lines of the Z80 CPU are active high, and $\overline{MREQ}$ is active low, a chip enable can be obtained with address line 15 on pin six, $\overline{MREQ}$ on pin five and address line 13 on pin four. Address lines A10 through 12 go to pins one through three. This gives a memory request pulse for addresses 36,864 through 45,056 depending on the number on lines A10 through A12. It is this pulse that controls our interface chips for the most part. I selected address 37,888 as the starting address of the 1K VRAM simply because it was easy to remember. The address pulse for this 1K is output on pin 10 of the 74LS138. This control pulse is used as the enable pulse for the address multiplexers and is combined with $\overline{MRD}$ through a NOR gate to open the 4066's which gate the VRAM data onto the computer's data buss.

If more than 16K of RAM is being used, it is quite possible to mount the board into the unused 8K area above the system ROM. The connections at the 74LS38 would need only minor revisions. This modification would give you the ability to run machine code from the video RAM.

Although it is not absolutely necessary, all lines are buffered with CMOS 4050 non-inverting buffers. These buffers will give the signals more drive but, more importantly, will give a little extra protection to the CPU in the event of a wiring error. The 4066s are the buffers for the data lines.

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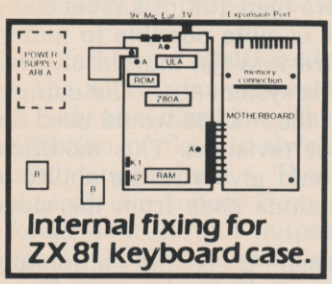
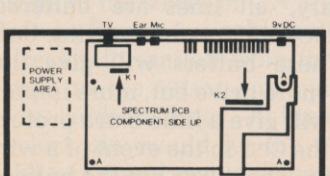


Internal fixing for ZX 81 keyboard case.



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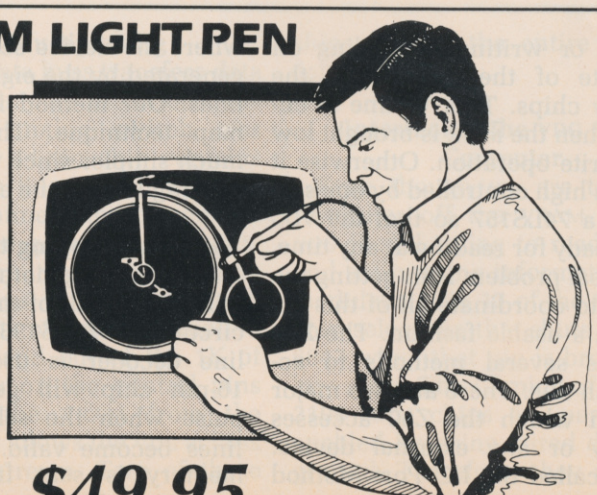

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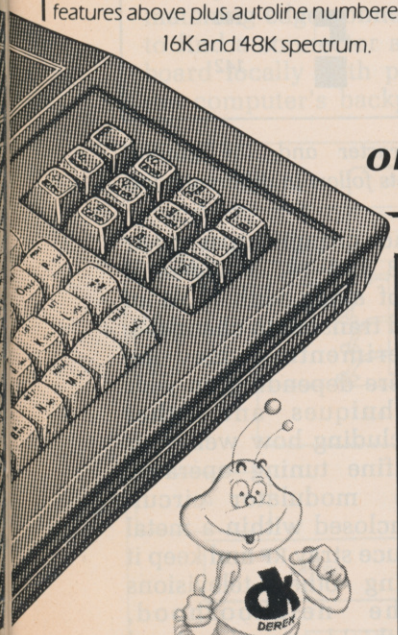

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A	65	Q	81	!	97	1	113				
B	66	R	82	"	98	2	114		129		136
C	67	S	83	#	99	3	115				
D	68	T	84	$	100	4	116		130		137
E	69	U	85	%	101	5	117				
F	70	V	86	&	102	6	118		131		138
G	71	W	87	'	103	7	119				
H	72	X	88	(	104	8	120		132		139
I	73	Y	89	)	105	9	121				
J	74	Z	90	+	106	;	122		133		140
K	75	L	91	+	107	;	123				
L	76	/	92	,	108	X	124		134		141
M	77	I	93	-	109	=	125				
N	78	1	94	.	110	X	126				142
O	79	-	95	/	111	?	127				

Figure 3. *The decimal for each alphanumeric character and the graphic symbol for the first set of color are shown. Seven more sets follow in different hues.*

There is only one interface problem remaining. Since the ROM which resides at location 00 is enabled each time the address exceeds 32,766, some means must be devised to keep the ROM disabled each time the VRAM is addressed. If a five volt level is applied to the ROMCS trace of the backplane the ROM's output is tri-stated or held off the data buss. Since there is a dropping resistor on this enable pin, no harm results when this is done. A 2N2222 NPN transistor which is driven by the multiplexing pulse of the address decoder accomplishes this nicely.

Color Modulator Operation

Sadly, the RF modulator that comes with the T/S,ZX will not handle color signals and a new one must be built. This task is greatly simplified, however, by the use of a MC1372 color modulator chip. Just hang on a 3.579 Mhz color burst crystal, a few capacitors, several resistors and a .01 uf RF choke and color comes through beautifully.

There are four color signals generated by the 6847 VDG. The luminance signal contains all of the black and white information along with sync and blanking signals. The three other lines contain the color information. A video clock signal is generated by the color crystal and its associated capacitors. These components generate the pulses that scan the VRAM and output the stream of video information to the modulator. The RF frequency is generated by the inductance circuit across the RF tank pins 13 and 14. A capacitor value of 56pf along with a .01 uf choke should transmit to channel 4. Some experimenting may be necessary here depending on your wiring techniques and other variables including how well your television's fine tuning operates. This entire modulator circuit should be enclosed within a metal shield to reduce stray RF and keep it from entering other televisions around the neighborhood, Without the shield, my color signal could be read all the way from the basement to the bedroom television upstairs. My wife and the FCC frown on this sort of thing.

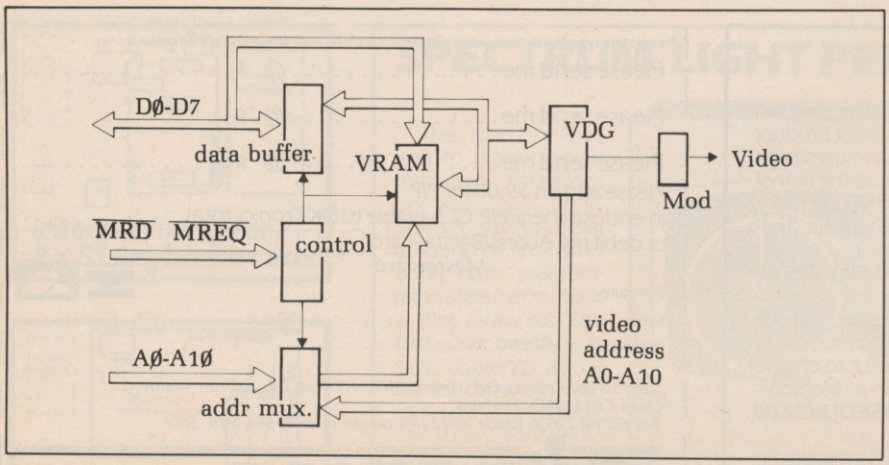

Figure 4. *Block diagram showing address and data paths.*

Video Signal Multiplexing

Although it is possible to use two modulators for the two video signals, the multiplexing of the raw video signal is easiest. Therefore, both signals can use the same modulator. Three gates of a 4066 switch are used to route the signals to the color modulator. The control for this is, again, the select pulse of the 74LS138. This time, however, we are using the next pin up on the chip which gives a select when the addresses 38912 through 39935 are called. I used 38990 since this number is easier to remember. But any number in this range will switch the screen. One section of

the 74LS02 NOR gate is used to combine MWR in order to avoid screen switching when the ROM is using the high address line to update the television frame counter.

Wire-Wrapping The Colorboard

I strongly suggest that an Archer 44-pin wire wrap board be used to mount the components. These are readily available along with the matching edge connectors. I've yet to find a connector and wire-wrap board locally with pin spacing of the computer's backplane. The 46

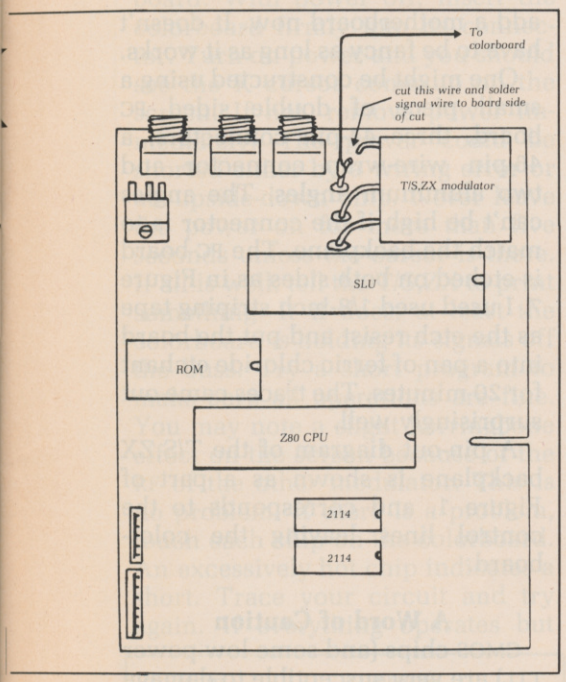

Figure 5. *Shows connection of signal wire from T/S,ZX. A toggle switch could be added that reconnects the wire to the original modulator.*

pin wire-wrap socket that I mail ordered for this project cost a small fortune.

Since much of the wiring in Figure 2 is "daisy-chain," I used the Just Wrap[tm] method. This technique is very fast since it eliminates all of the required stripping. Just remember to wrap at least five turns on each post and a good connection is assured every time. Its only disadvantage is that you run out of space on the post if you have to wrap more than three connections to one point. I switch to regular wire wrap when I start running out of space on the wire wrap pin.

The best method of assuring that all lines have been connected is by making a photocopy of the schematic and checking off each completed connection with a red pen. Because there are so many lines and connections, this method can later save hours of circuit tracing. Connections can be missed if some means of checking is not used.

Unless you have wire-wrapped at least 100 projects I recommend that each chip be labeled with a small strip of paper glued between the pins. Pin 1 of each chip should be clearly marked. This is a tedious procedure, but can save hours of rewiring a section that is wired backward. I speak from experience. Every other pin on the 40-pin chip should be numbered to reduce pin counting and probable errors.

Stacking The RAM Chips

Even though two 2114 RAM chips could be used, and probably should be, I elected to use 2102s since I had a few gathering dust. The disadvantage, of course, is that eight chips take up a lot of board space, use up a lot of wire wrap and cost a bundle in wire wrap sockets. Since all of the pins of the 2102s are wired in common except two on each chip, I've found it easier and cheaper to stack these chips in two groups of four each. The pins in common are soldered to each other and the data in and data out pins are bent carefully out at right angles and the wire wrap is soldered directly to these. This method only takes two sockets and one fourth of the space and wire. Just remember to use a good quality, low-watt soldering iron when soldering the pins.

All of the discrete components (resistors, and so on) are inserted into two 14 pin wire-wrap sockets.

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All resistors should be 1/8th watt. Figure 6 shows the suggested component layout but placement is not critical except in the modulator circuit. Remember to keep the runs as short as possible for this section.

Scramble type wiring seems to work best because it seems to reduce crosstalk. At these high frequencies it may be necessary to add several .1uf decoupling capacitors across the power traces at various locations. I haven't found this necessary, however.

Fine Tuning

Due to the two entirely different loads and sync frequencies of the video signals, it may be necessary to fine tune the television after calling the second screen. This could get to be quite a headache if you called the two screens very often. However, frequent switching between screens will usually be done only when a program is being checked for proper operation or bugs. Once a color program is running, there is little if any need to switch between screens. It is quite possible using software, to call a copy of the computer program onto the color screen for viewing. This is the technique I'm exploring now.

Construction of the Backplane Adaptor and Motherboard

The colorboard will operate just fine with only the original 1K or 2K RAM. Most T/S,ZX owners have or will eventually buy the 16K RAM module. You may want to use the colorboard and the RAM pack at the same time; if so, you'll need a backplane adapter. Since you probably will want to build other project boards, you may just as well add a motherboard now. It doesn't have to be fancy as long as it works.

Figure 7. *Printed circuit board for buss extension. The use of 1/8 inch adhesive layout tape simplifies the etching process.*

One might be constructed using a small piece of double sided PC board, three 44-pin connectors, a 46-pin wire-wrap connector and two aluminum angles. The angles can't be high if the connector is to match the backplane. The PC board is etched on both sides as in Figure 7. I used used 1/8-inch striping tape as the etch resist and put the board into a pan of ferric chloride etchant for 20 minutes. The traces came out surprisingly well.

A pin-out diagram of the T/S,ZX backplane is shown as a part of Figure 1, and corresponds to the control lines leaving the colorboard.

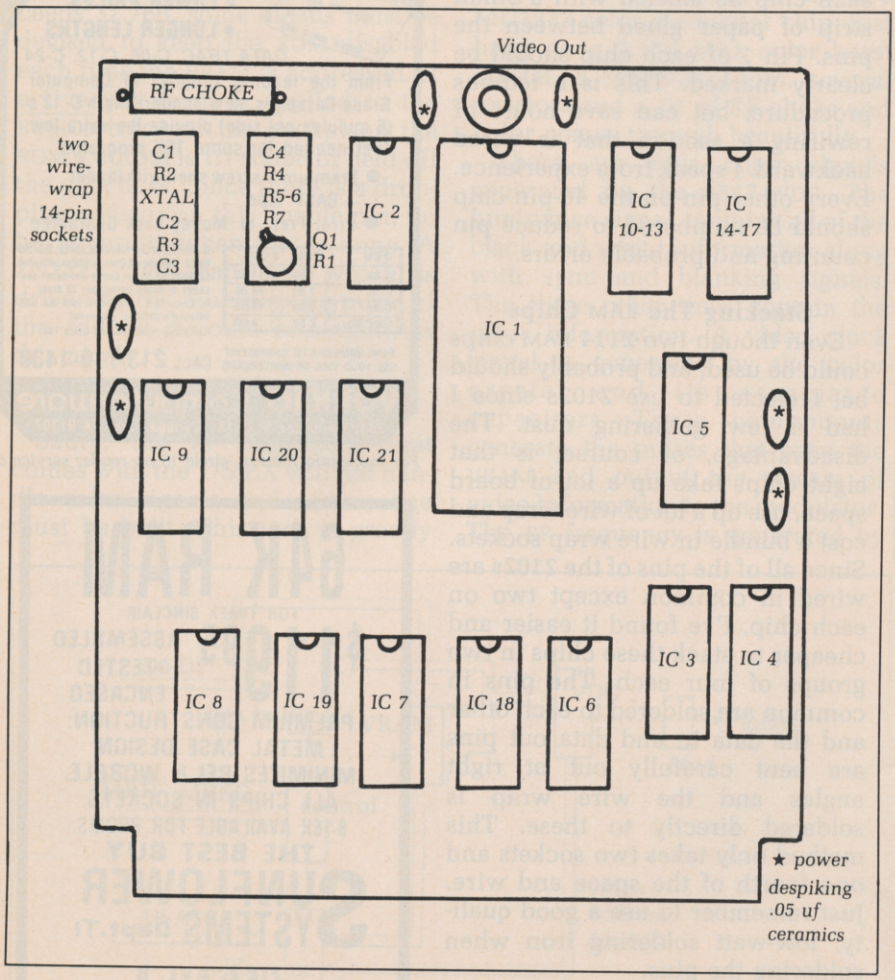

Figure 6. *Diagram showing placement of components. The layout is not critical. Keep the components for the modulator as close as possible to lessen wire runs and for proper shielding.*

A Word of Caution

CMOS chips (and some low-power TTL) are very susceptible to damage from static electricity. Take every precaution to eliminate static build-up on yourself. Avoid wearing synthetic clothes and sweaters while working.

Never work around carpet and plastic sheets. Always keep the chips in their protective foam until you are ready to insert them into the sockets. Always double-check the circuit before inserting the chips. Check the power to each socket with an ohmmeter first. If a chip is inserted into the socket upside down they are usually ruined if power is applied. I've operated the board for two months and no pro-

blems have been noted with either the colorboard or the computer but nothing can be guaranteed in this business.

Operation and Troubleshooting

With the RAM pack, colorboard and motherboard disconnected from the computer, verify that the T/S,ZX is operating properly and transmitting to channel 3. Switch the power off and attach the motherboard only. Verify that the T/S,ZX is operating properly. If not, you probably have a short in the wiring or traces of the extension board. With power off, insert the colorboard firmly into its connector. Turn on power and you should see the K cursor come up on the screen. If not, remove power immediately. The power could be shorted either by a wiring error or an upside-down chip. Never leave the power on for more than five seconds unless the cursor is there. If all is well, tell the T/S,ZX to print something. It if does, at least the colorboard is holding its signals off the buss. Try a short program to make sure all operations are fine. You may note a slight herringbone effect on the screen because of the RF of the other modulator. This is no problem. If there is a problem, touch each chip on the colorboard. An excessively hot chip indicates a short. Trace your circuit and try again. If everything operates but there are dark bars that move slowly up the screen, then the power supply is being loaded down and the filters are letting ripple through. Don't operate with this condition. It will cause glitches and shorten the life of your system. I have the 650 ma supply and no ripple is noted. It seems to handle the load just fine. I understand that some of the earlier systems came with smaller supplies. You may want to check your supply before starting construction. If you still get no cursor but occasionally a stable fouled up video, the multiplexers are probably letting data or addresses onto the buss either because of a wiring error in the control lines or a bad chip. If the T/S,ZX operates right, you are now ready to check out the colorboard.

Program	*Comments*
5 POKE 38990,1	*switch screens*
10 LET Y = 37888	*start of color screen*
20 LET X = 0	*decimal value of first character*
30 IF INKEY$ = " " THEN GOTO 30	*wait*
40 IF X = 255 THEN GOTO 70	*stop if all values entered*
50 POKE Y,X	*place character on screen*
55 LET Y = Y+1	*increment address*
60 LET X = X+1	*increment character value*
65 GOTO 40	*do another character*
70 STOP	

Figure 8. *Test Program for the T/S,ZX colorboard prints complete set of characters and graphic symbols.*

> When using CMOS chips, guard against static electricity

Plug the T/S,ZX into the new modulator and switch to channel 11. With the colorboard and motherboard plugged into the backplane, turn on power. You should see the screen change radically when this is done. You may get a weird pattern which means that the RF is reaching the television but your tuning is not correct. You will have to fine-tune until a clear picture is obtained. On my first try, I even had to switch over to channel 8 before a good picture was obtained. I had used a different value choke which I felt would work.

Once you get a clear picture, you should see a complete screen of characters in a random mosaic and in various colors if you're connected to a color set. The use of a black and white set is fine for testing, however. A set that has a wide range of fine tuning makes finding the picture much easier. It could happen that several variables and a small width of fine tuning work to your advantage. If the co-

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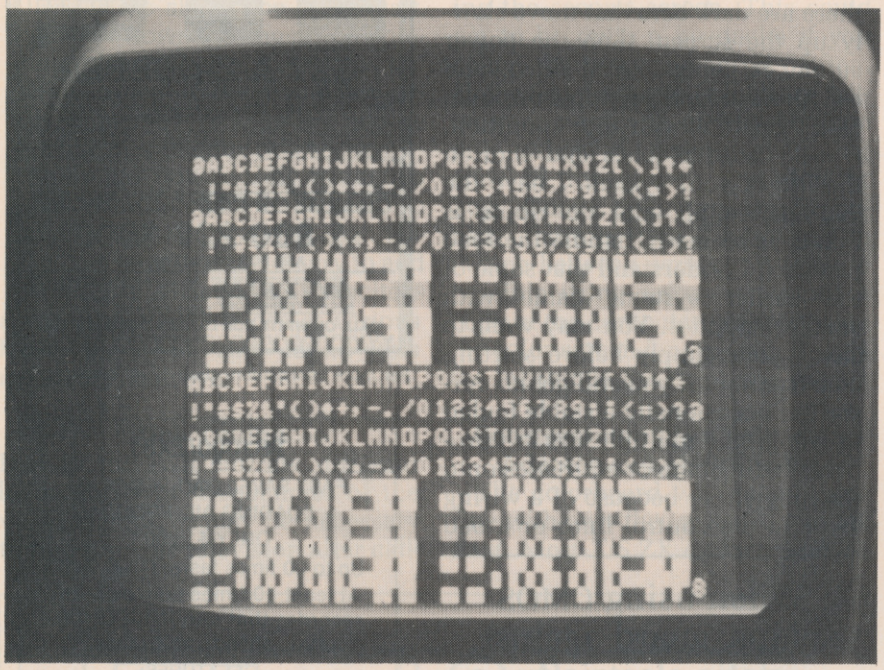

Figure 9. *Output of screen showing all alpha and graphic characters after running the test program.*

lorboard and the regular video are close to the edge of the channel, it is simpler to tune each of the two channels separately and simply switch channels each time rather than fine-tune. Of course, the optimum would be the exact setting for both screens. Maybe one of you will know how to accomplish this little feat.

Checking Out the Colorboard

Figure 8 is a small BASIC program that prints all the graphic symbols and the complete alphanumeric character set on the colorboard screen. This is the test program to assure proper operation of the colorboard. Enter this little program and hit run. Fine tune in the colorboard screen and touch any key. The colorboard screen should slowly fill with the full character set twice. If data is being entered but not as shown in Figure 9, either your 2N2222 is not holding the ROM off the buss or one or more of the 4066 chips is not operating properly. Check the wiring and, if necessary, switch the 4066s around to see if it makes a difference. If the characters entered are consistently wrong, such as As showing up as Ts, then one of the data lines is probably wired wrong or shorted. If only one character is being placed across the screen, you either left out something in the program or the data switches are not opening. If you don't get the mosaic but rather just one character, the address multiplexers are not operating and the VDG is reading just one location. The only known cure for most of these occurrences is wire tracing.

The above is not meant to discourage you but to help in case of trouble. My board worked the first time . . . well, at least I got a mosaic. Two weeks later I got proper operation. So don't feel too bad if you have to troubleshoot a little.

Summary

I realize that many of you already know some of the procedures and techniques covered above. I've included a lot for the beginner. This project is simple enough for one who is just starting to build from scratch, but some knowledge of electronics is a must. Even if you decide not to construct the board, I feel there is a great deal of information here which can be used with other projects. I'll be glad to try to answer any questions you might have, again just for the price of a stamped envelope. I realize that there is nothing invented that can't be improved, and would appreciate knowing of any improvements you make or bugs you find. ⊘/⊘

References

Z80 Microprocessor Programming and Interfacing
by J.C. Nichols, E.A. Nichols and P.R. Rony

TV Typewriter Cookbook
by Don Lancaster

Computer Data Handling Circuits
by Alfred Corbin

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Parts List

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IC 5	74LS138 3-8 Decoder/ Demultiplexer (.55)
IC 6,7,8	74LS157 Quad 2 input Data Selector (1.95)
IC 9	74LS02 Quad 2-input NOR gate (.25)
IC 10-17	2102 1K Static RAM (8.80)
IC 18,19	4050 CMOS non Inverting Buffers (.70)
IC 20	74LS73 Dual J/K Flip Flop (.39)
R1	680 ohm (.05)
R2	5.6K ohm (.05)
R3	750 ohm (.05)
R4,5,6	240 ohm (.05)
R7	75 ohm (.05)
C1	50pf (.15)
C2	10 to 35 pf (select for best picture) (.15)
C3	.1 uf (.15)
C4	56 pf (.15)
C5	.01 uf (.15)
Q1	2N2222 NPN switching Transistor (.50)
RF1	RF Choke 100uf + or - 10 (1.50)

All resistors 1/8th watt
All capacitors ceramic wafer

Total cost of colorboard is $62.05.

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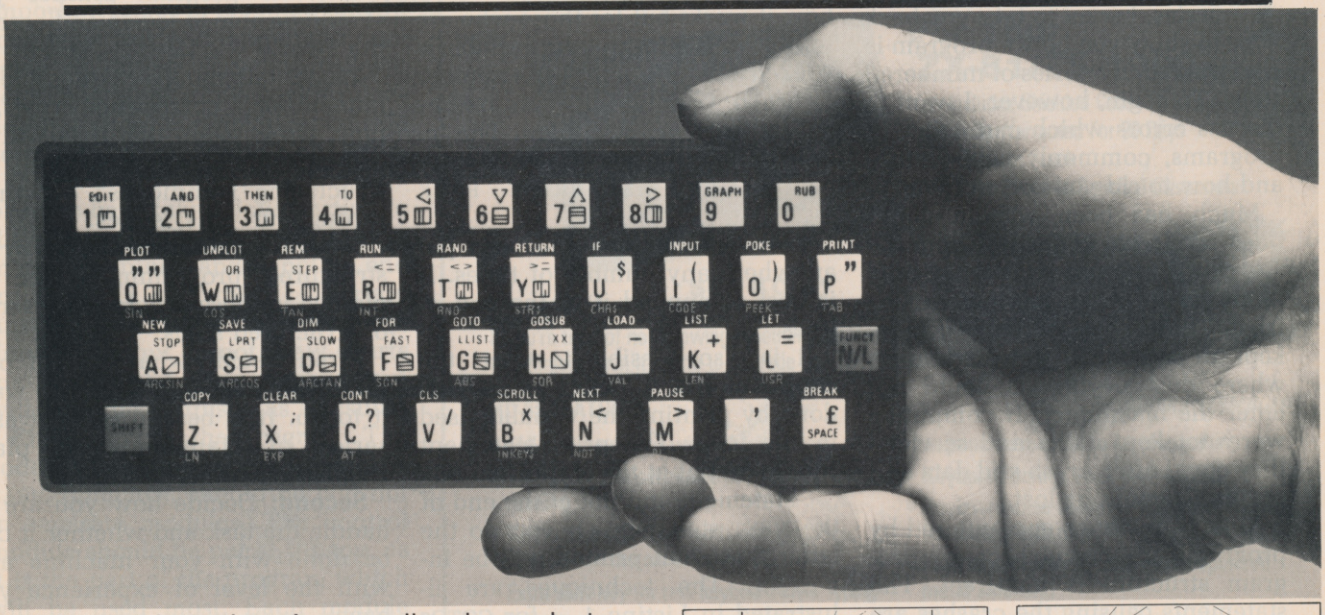

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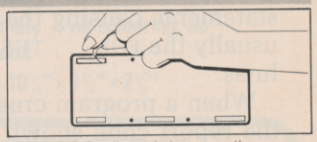
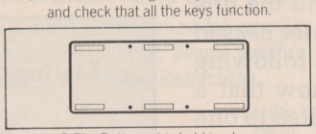
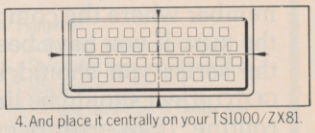


3. So all you do is remove the protective backing.



2. The Buttonset is held in place by self-adhesive pads.



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Clearing system bugs

John Gilbert completes his five-part series on how to write your own programs in BASIC by showing how to find and correct errors

IN THE FINAL article of the series, I want to take you back to show you how a program is constructed in a series of numbered steps. To begin, however, I want to discuss errors which can occur in programs, commonly called bugs, and how to rid yourself of them.

Much has been written about bugs. The term is derived from the early days of computing when only large mainframe computers existed. They had to be, and still are, kept in specially protected areas where dust or insects could not enter the machinery. If computers were not kept clean and serviced they could often crash and data and programs could be lost.

Most of the bugs encountered by programmers occur because program structure is incorrect. The statements causing the crashes are usually the FOR . . . THEN and GOTO lines.

When a program crashes, look at the report code shown on the bottom of the screen and find the line number where the computer ceased the RUN. If you have been following the series you should know that a GOTO effect should be limited to one routine. If an error occurs at a certain line you have to look at that routine.

On some computers, the system offers a command which prints out the line number to which the computer goes during operation. It is called the TRace ON (TRON) routine. It can be simulated if you wish to add an extra instruction to each of the troublesome lines. That instruction will make the computer print out each line number as it is executed.

It is not important that you know how it works but for those who are interested the PPC system variable is PEEKed and the current line number returned from the two addresses accessed by the statement. The instruction to be appended to program lines is: PRINT PEEK 16391 + 256*PEEK (16392).

That instruction can be put anywhere any number of times. It is best to append it to the end of lines.

It is also possible to chart the course of FOR . . . NEXT loops. It is done by printing the variable used in the loop. The print statement should be put at the end of the FOR . . . statement and not at the end of the NEXT statement. If you do the latter the count printed will be incorrect. The techniques are illustrated in Listing 1 — for GOTOs and Listing 2 for FOR . . . NEXT.

The two techniques can be incorporated together in a program and, with the error message you get when the program crashes you should be able to locate and correct the error.

When talking about these techniques and correcting errors, I must stress again that they will be of help only if you have used the structuring techniques explained throughout this series.

I have detailed the pathway to structured programming, as explained in these articles, as a series of structured steps:

First: Decide what type of program you want and what you want it to do. It is best to write it as a series of statements in plain English.

Second: Decide how you are to handle the task and whether it can be done with your machine and with the level of experience you have.

Third: Break the task into a series of headings and sub-headings. For example, most programs need some form of instructive display —

Listing 1

```
10 PRINT PEEK 16391+256
*PEEK 16392
20 PRINT PEEK 16391+256*PEEK
16392
30 GOTO 10
```

Listing 2

```
10 FOR K=1 TO 10
20 PRINT K
30 PRINT
40 NEXT K
```

The term 'bugs' is derived from the early days of computing, when large mainframe computers were protected from dust and insects

an entry procedure, a calculation procedure and an output procedure. They must be tailored to meet your needs.

Fourth: Draw a flowchart. That should take a long time in many cases. It is a good idea to draw several charts, expanding the most important boxes in the main one. In that way you will know the concepts of the program before you begin coding. If flowcharting does nothing else it will concentrate your mind on what you want to do.

I have a word of warning to people who have taken flowcharting to their hearts. The technique is a means to an end and is not an end in itself. If you think a certain number of charts is necessary, draw them, but do not draw charts for the sake of doing so because you will often be confused as a result.

Fifth: Coding the program. The code, in this case using the Sinclair BASIC language, should be laid out in separate modules. The control module should be put at the top, as it is the part of the program which will be used most. Each module should be complete and GOTO statements should be local to a module if possible.

Sixth: In long programs, bugs or errors, are liable to occur frequently. Bugs occur usually in the data entry parts of the program and in the flow structure. Flowcharting and structured programming will not dispose of all bugs but it will eliminate a few.

If you have followed the series you should be able to write reasonably complicated programs. As I have stressed, there are two factors which are important, more so than some of the others, which are necessary to make programming easier and more enjoyable.

The first is structure. If your program is well-structured, it will contain fewer bugs and will, in most cases, run faster. The second point is that the program must be designed for ease of use, so that it can be used by someone who knows nothing about computers.

If you have taken my advice, or even modified it using your own techniques, you are on the way to being an efficient programmer. You will find that you can do more and programming will become less difficult and more rewarding.

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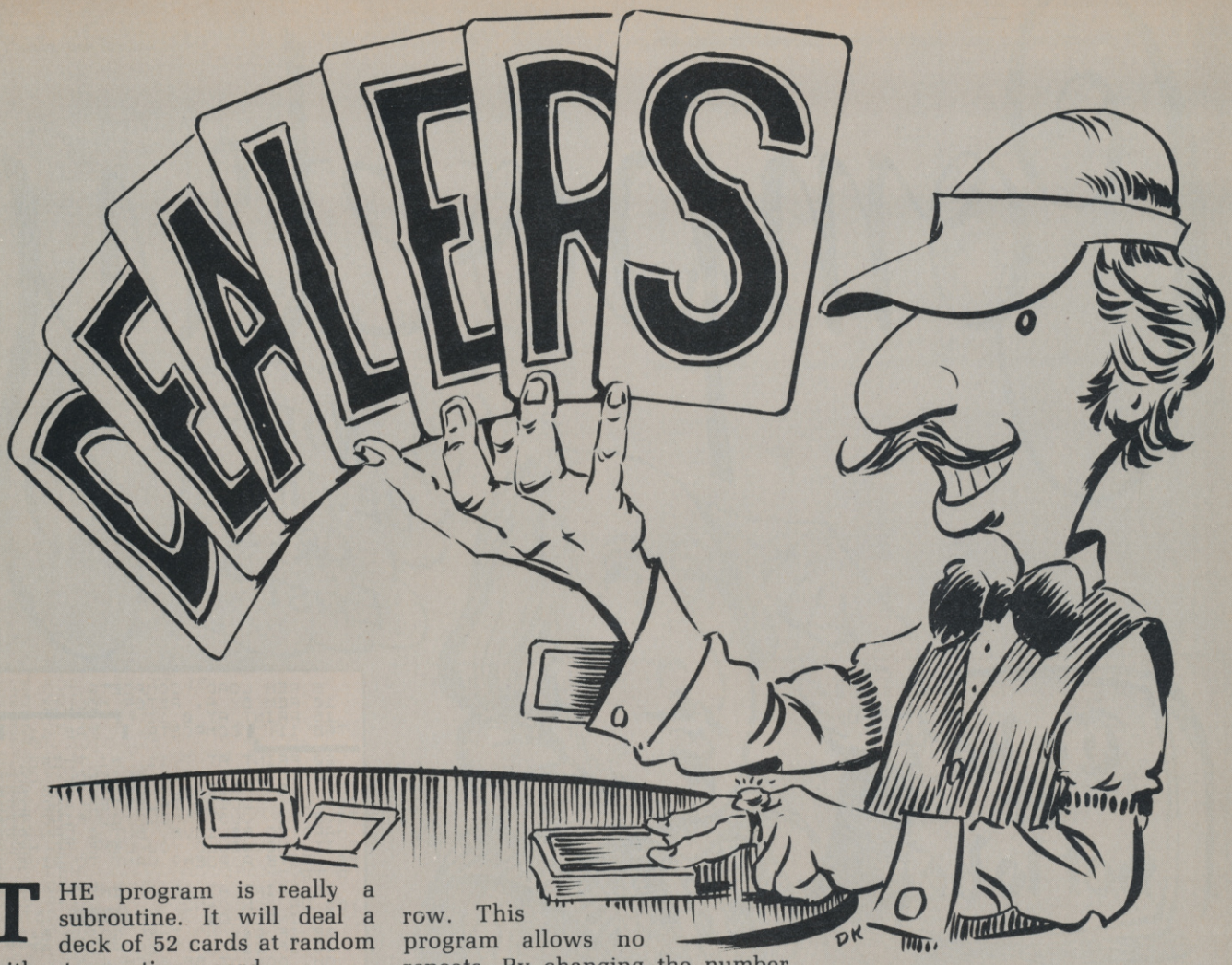
PROGRAM PRINTOUT

HAVE YOU EVER had a dull, hard to remember telephone number? David Wahl's **Dial-a-word** program will help you discover fun and excitement concealed in telephone numbers.

Just enter the seven digit telephone number, with hyphenated prefix and the letters corresponding to the number will scroll up the screen. To pause or change numbers, touch any key as a line is completed.

Four and five letter word/number combinations are more likely than a full 7 letter word. People with 0's and 1's in their number should look for combinations like "NUMBER-1", "ROUTE-13", 1-WAY", and "FAST-Operator". (2K Timex/Sinclair 1000)

```
   1 REM  DIAL-A-WORD
   2 REM  DAVID WAHL  1983
  10 LET A$="ABCDEFGHIJKLMNOPRST
UVWXY"
  20 CLS
  30 PRINT AT 10,6;"ENTER PHONE
NUMBER";TAB 11;"E.G. 234-5678"
  40 INPUT B$
  50 IF LEN B$=8 THEN GOTO 80
  60 PRINT AT 9,6;" PLEASE "
  70 GOTO 40
  80 SCROLL
  90 FOR A=1 TO 3
 100 FOR B=1 TO 8
 110 IF CODE B$(B)<30 OR CODE B$
(B)>37 THEN PRINT B$(B);
 120 IF CODE B$(B)<30 OR CODE B$
(B)>37 THEN GOTO 140
 130 PRINT A$((VAL B$(B)-1)*3-IN
T (RND*3));
 140 NEXT B
 150 PRINT "  ";
 160 NEXT A
 170 IF INKEY$="" THEN GOTO 80
 180 PRINT AT 0,0;" ANOTHER NUMB
ER? "
 190 INPUT C$
 200 IF C$(1)="Y" THEN GOTO 20
 210 GOTO 80
```



THE program is really a subroutine. It will deal a deck of 52 cards at random without repeating a card.

The first part of the program (lines 1000 to 1080) loads the names of the 13 different cards into a string variable C$. This could have been done by 13 LET statements such as LET C$(1) = "ACE" and LET C$(2) = "DEUCE" and so on, but this little routine is my substitute for a READ/DATA statement in Sinclair BASIC. Put all your data in A$ with no spaces between items, and put the number of characters in each item as a two-digit number in B$. Thus, the first two-digit number in B$ is 03, signalling the fact that the first data item in A$ is three letters long. By setting up data in these strings you can consecutively load data into C$. This mimics a READ/DATA statement.

The second part of the program is a random number generator. This routine will generate any number of random integers without repeating an integer. Those who have used the RND function know how frustrating it is when the machine randomly comes up with the same number three times in a row. This program allows no repeats. By changing the number 52 in lines 1110, 1120 and 1130 to any number you wish, the program will count up to that number in random order. The higher the number, the longer the program will take. I must warn you that the machine is slow at this, even in FAST mode.

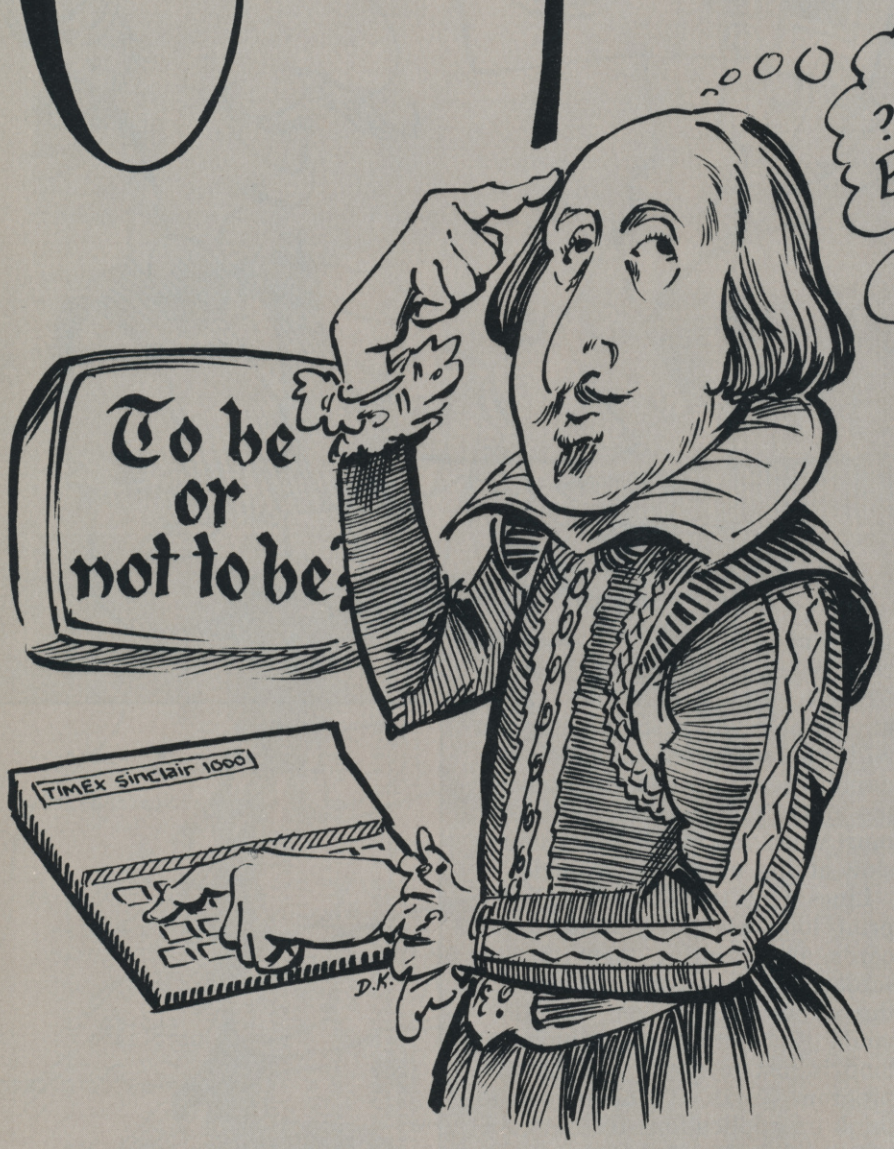
Lines 1290 to 1350 are a simple print loop assigning suits to the cards and printing them on the screen. You'll get a 5 error when the screen fills. If you hit CONT, you'll get more cards. The print loop is just to show you that the program works. It's up to you to think up applications for the computerized dealer. For instance, you could delete lines 1290 and 1350 and put in a new line 1290 which brings you into your main program. Then you could use a GOSUB 1300 to deal a card. Remember to advance the value of X after each card is dealt and remember to put in a RETURN command at 1350.

May the cards be with you.

Submitted by Frank Terranella of Sloatsburg, N.Y.
(T/S1000,1500,ZX81 16K).

```
1000 REM CARDS
1001 FAST
1005 LET A$="ACEDEUCETHREEFOURFI
VESIXSEVENEIGHTNINETENJACKQUEENK
ING"
1010 LET B$="0305050404030505040
3040504"
1020 LET A=1
1030 LET N=0
1035 DIM C$(13,5)
1040 FOR B=1 TO (LEN B$/2)
1050 LET C$(B)=A$(N+1 TO VAL B$(
A TO A+1)+N)
1060 LET N=VAL B$(A TO A+1)+N
1070 LET A=A+2
1080 NEXT B
1100 REM RANDOM ROUTINE
1110 DIM A(52)
1120 FOR X=1 TO 52
1130 LET A(X)=INT (RND*52)+1
1140 IF X>1 THEN GOTO 1200
1160 NEXT X
1200 LET Y=X-1
1210 IF A(X)<>A(Y) THEN GOTO 1230
1220 GOTO 1130
1230 LET Y=Y-1
1240 IF Y=0 THEN NEXT X
1250 IF X<=52 THEN GOTO 1210
1289 SLOW
1290 FOR X=1 TO 52
1300 IF A(X)<=13 THEN PRINT C$(A
(X))" OF SPADES"
1310 IF A(X)>=14 AND A(X)<=26 TH
EN PRINT C$(A(X)-13)" OF DIAMON
DS"
1320 IF A(X)>=27 AND A(X)<=39 TH
EN PRINT C$(A(X)-26)" OF CLUBS"
1330 IF A(X)>=40 AND A(X)<=52 TH
EN PRINT C$(A(X)-39)" OF HEARTS"
1350 NEXT X
```

Compoetry




```
   5 REM LOAD "COMPOETRY"
  10 REM BY A. PETER HOLLIS
  15 PRINT AT 0,11;"▗▄▄▄▄▄▄▄▄▄▄▄▄▄▄▖
";TAB 11;"▐ COMPOETRY ▌";TAB 11;"▝▀▀▀▀▀▀▀▀▀▀▀▀▀▀▘
"
  20 PRINT AT 7,11;"HI THERE..."
;TAB 0;"I""M YOUR FRIENDLY COMPU
TER. WE  FRIENDLY COMPUTERS ARE
REALLY  QUITE TALENTED AND CREA
TIVE, I  JUST KNOW YOU FIND THAT
 HARD TO BELIEVE, BUT I CAN PROV
E IT. HOWWOULD YOU LIKE TO HELP
ME WRITE A POEM? WANT TO GIVE IT
 A TRY?"
  25 PRINT AT 20,0;"ENTER ""Y""-
YES OR ""N""-NO."
  30 INPUT Q$
  35 IF Q$="N" THEN GOSUB 840
  40 IF Q$="N" THEN PRINT AT 7,0
;"OH, DON""T BE SUCH A SILLYKINS
.  OF COURSE YOU WANT TO HELP ME
   WRITE A POEM. BESIDES, IF YOU
 DONOT, I SHALL ZAP YOU. I SHALL
   HAVE ALL YOUR CREDIT CARDS VO
ID-ED. WE FRIENDLY COMPUTERS ARE
   NOT WITHOUT WORLDLY POWER, EV
EN IF WE ARE EXTREMELY SENSITIVE
."
  45 IF Q$="N" THEN GOTO 65
  50 IF Q$="Y" THEN GOSUB 840
  55 IF Q$="Y" THEN PRINT AT 7,0
;"OH, I AM SO GLAD, I JUST KNOW
  THAT IF YOU HAD SAID ""NO"" I
   SHOULD HAVE DONE SOMETHING T
ER- RIBLE; PERHAPS I SHOULD HAVE
   CAUSED YOUR PHONE NUMBER TO
BE  THE SAME AS THAT OF AN ALL-N
IGHTBOOKIE. WE FRIENDLY COMPUTER
S   CAN BE SO VENDICTIVE."
  60 IF Q$<>"Y" THEN GOTO 30
  65 PRINT AT 21,0;"PRESS ""ENTE
R"" TO CONTINUE."
  70 INPUT E$
  75 REM ********A/NOUNS********
  80 GOSUB 840
  85 PRINT AT 5,0;"SO, WE BEGIN."
  90 PRINT
  95 PRINT "ENTER 5 RELATED NOUN
S OF 6 LET- TERS OR LESS, (HINT:
 NONSENSE  WORDS ARE NEVER FORB
IDDEN.)"
 100 GOSUB 870
 105 LET CT=1
 110 LET A=1
 115 DIM A$(5,6)
 120 FOR Y=11 TO 15
 125 GOSUB 910
 130 INPUT A$(A)
 135 IF A$(A)<"A" OR A$(A)>="RND
" THEN GOTO 130
 140 PRINT AT Y,13;A$(A)
 145 GOSUB 925
 150 INPUT Q$
 155 IF Q$="N" THEN GOTO 125
 160 IF Q$<>"Y" THEN GOTO 150
 165 LET CT=CT+1
 170 LET A=A+1
 175 NEXT Y
 180 REM *****B/ADJECTIVES*****
 185 GOSUB 840
 190 PRINT AT 7,0;"NOW ENTER 5 R
ELATED ADJECTIVES OF 6 LETTERS
OR LESS, (HINT: BE DRAMATIC.)"
 195 GOSUB 870
 200 LET CT=1
 205 LET B=1
 210 DIM B$(5,6)
```

THIS is a fun and humorous program. You input a list of nouns, verbs and adjectives, and the computer creates a poem. The poetry is of somewhat lesser quality than that produced by Joyce Kilmer, but somewhat better than the stuff members of the Beat Generation heard in coffee houses. As a matter of fact, it falls within that genre.

The program is user friendly, and can be shortened considerably on that account. The nature of the verses(?) produced can be changed by altering lines 730, 740, 750 and 760. Alternative words can be substituted in lines 590 to 635 and 645 to 690. The program is fun to play with, and can produce extremely interesting results.

Submitted by A. Peter Hollis of Wilson, N.C. (T/S1000,1500,ZX81 16K).

ELEMENTAL

BRIGHT, BRIGHT FIRE FLAMES
THEN GREEN AIR RAINS,
AS FRESH FIRE GROWS OVER,
THE SWEET EARTH GROWS OVER.
SWEET, SWEET EARTH FLAMES,
THEN NEW AIR BLOWS,
AND NEW WATER GROWS OVER,
THE NEW FIRE RAINS EVER.
FRESH, FRESH WATER GROWS,
WHEN SWEET EARTH BLOWS,
AS NEW EARTH FLIES JOYOUS,
HOW BRIGHT WATER FLAMES FLYING.

SUB-ELEMENTAL

COLD, COLD WATER OOZES,
EVEN DARK WATER WAITS,
A DARK EARTH DIES DARKLY,
AND COLD FIRE WAITS NEVER.
DARK, DARK NIGHT WAITS,
WHAT DEAD GLOOM WAITS,
SO BLACK NIGHT CRIES NEVER,
SO BLACK NIGHT OOZES STARK.
DREAD, DREAD EARTH DIES,
THE COLD NIGHT OOZES,
THE DARK WATER LIES AWFUL,
HOW DREAD GLOOM DIES DEADLY.

FOOD ON THE ARKTURRIAL TABLE

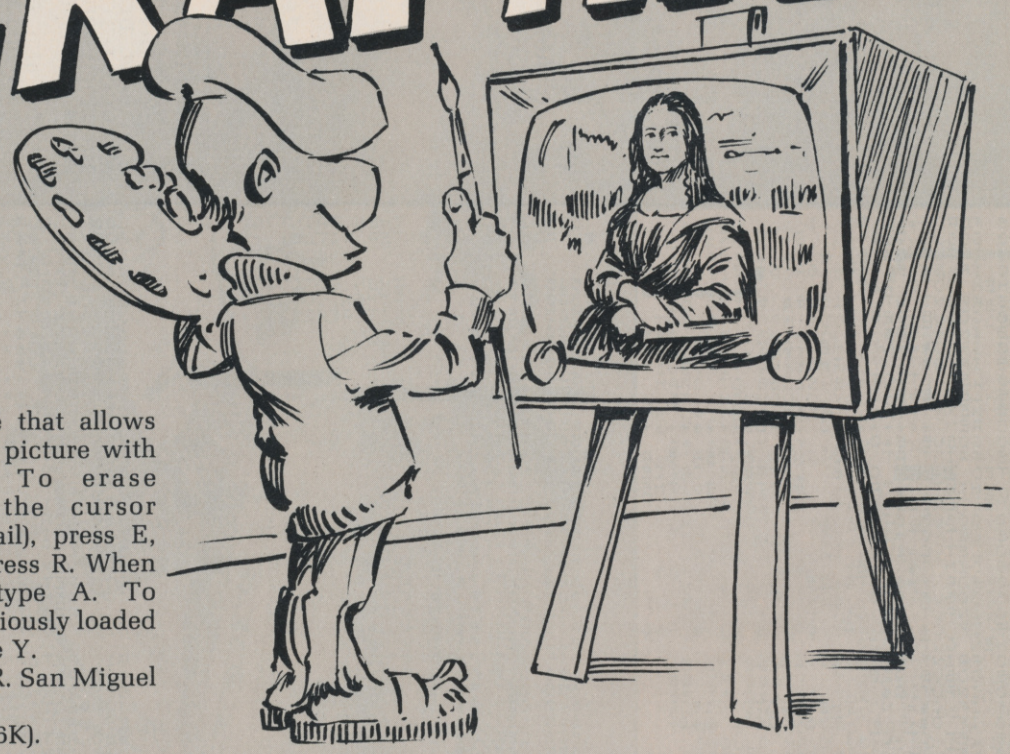
GOOEY, GOOEY QUAIL DROPS,
THEN GOOEY MOOSE FLIES,
SO FAT QUAIL RUNS ABOUT,
THE PURPLE WHALE FLIES IN.
FAT, FAT WHALE DROPS,
WHEN GREASY WHALE JUMPS,
THE PURPLE QUAIL LEAPS ABOUT
OR PURPLE MOOSE LEAPS AGAIN.
PURPLE, PURPLE WHALE DROPS
THEN PURPLE CAMEL LEAPS,
AS FAT CAMEL FLIES AGAIN,
AS GOOEY MOOSE JUMPS ABOUT.

FOOD ON THE ARKTURRIAL TABLE

FAT, FAT CAMEL LEAPS,
EVER GOOEY GOOSE JUMPS,
YET FAT GOOSE RUNS IN,
THE GREASY CAMEL JUMPS IN.
GOOEY, GOOEY WHALE RUNS,
THE FAT CAMEL JUMPS,
FOR LEAN QUAIL LEAPS IN,
A PURPLE WHALE FLIES WHOOPS.
GOOEY, GOOEY CAMEL RUNS,
EVER FAT CAMEL FLIES,
FOR LEAN MOOSE DROPS WHOOPS,
HOW GOOEY QUAIL LEAPS OUT.

```
 215 FOR Y=11 TO 15
 220 GOSUB 910
 225 INPUT B$(B)
 230 IF B$(B)<"A" OR B$(B)>="RND
" THEN GOTO 225
 235 PRINT AT Y,13;B$(B)
 240 GOSUB 925
 245 INPUT 0$
 250 IF 0$="N" THEN GOTO 220
 255 IF 0$<>"Y" THEN GOTO 245
 260 LET CT=CT+1
 265 LET B=B+1
 270 NEXT Y
 275 REM ********C/VERBS********
 280 GOSUB 840
 285 PRINT AT 7,0;"NOW ENTER 5 R
ELATED VERBS OF 6  LETTERS OR LE
SS.  (HINT:  STAY     MOSTLY IN THE
 SAME TENSE.)"
 290 GOSUB 870
 295 LET CT=1
 300 LET C=1
 305 DIM C$(5,6)
 310 FOR Y=11 TO 15
 315 GOSUB 910
 320 INPUT C$(C)
 325 IF C$(C)<"A" OR C$(C)>="RND
" THEN GOTO 320
 330 PRINT AT Y,13;C$(C)
 335 GOSUB 925
 340 INPUT 0$
 345 IF 0$="N" THEN GOTO 315
 350 IF 0$<>"Y" THEN GOTO 340
 355 LET CT=CT+1
 360 LET C=C+1
 365 NEXT Y
 370 REM *******D/ADVERBS*******
 375 GOSUB 840
 380 PRINT AT 7,0;"NOW ENTER 5 D
VERBS OF 6 LET-   TERS OR LESS.
  (HINT:  THIS IS A  GOOD PLACE FO
R RHYMES.)"
 385 GOSUB 870
 390 LET CT=1
 395 LET D=1
 400 DIM D$(5,6)
 405 FOR Y=11 TO 15
 410 GOSUB 910
 415 INPUT D$(D)
 420 IF D$(D)<"A" OR D$(D)>="RND
" THEN GOTO 415
 425 PRINT AT Y,13;D$(D)
 430 GOSUB 925
 435 INPUT 0$
 440 IF 0$="N" THEN GOTO 410
 445 IF 0$<>"Y" THEN GOTO 435
 450 LET CT=CT+1
 455 LET D=D+1
 460 NEXT Y
 465 REM *******E/TITLE********
 470 GOSUB 840
 475 PRINT AT 7,0;"HAVE YOU THOU
GHT OF A TITLE FOR OUR POEM?  I K
IND OF LIKE ""ODE TOA NIGHTENGAL
E,"" OR ""IT TAKES A  HEAP A-LIV
IN,"" ON THE OTHER HAND""TREES""
 IS KIND OF SNAPPY, NO?  IF YOU
ARE SO GOOD AT TITLES,  THEN YO
U DECIDE."
 480 PRINT AT 20,0;"ENTER TITLE,
 (NOT MORE THAN ONE LINE, PLEASE
.)"
 485 INPUT E$
 490 IF E$="" THEN GOTO 485
 495 PRINT AT 16,0;E$
 500 GOSUB 925
 505 INPUT 0$
 510 IF 0$="N" THEN PRINT AT 20,
0;"PLEASE RE-ENTER TITLE,
                "
 515 IF 0$="N" THEN GOTO 485
 520 IF 0$<>"Y" THEN GOTO 505
 525 REM ******GET READY********
 530 GOSUB 840
 535 FOR E=1 TO 5
 540 FOR F=1 TO 5
 545 PRINT AT 10,0;"OKAY, GET RE
ADY, HERE IT COMES."
 550 NEXT F
 555 FOR G=1 TO 5
 560 PRINT AT 10,0;"OKAY, GET RE
ADY, HERE IT COMES."
 565 NEXT G
 570 NEXT E
 575 REM *ARTICLES/CONJUNCTIONS*
 580 GOSUB 840
 585 DIM F$(10,4)
 590 LET F$(1)="A"
 595 LET F$(2)="THE"
 600 LET F$(3)="THAT"
 605 LET F$(4)="THEN"
 610 LET F$(5)="WHEN"
 615 LET F$(6)="WHAT"
 620 LET F$(7)="WHY"
 625 LET F$(8)="NO"
 630 LET F$(9)="EVER"
 635 LET F$(10)="EVEN"
 640 DIM G$(10,3)
 645 LET G$(1)="A"
 650 LET G$(2)="THE"
 655 LET G$(3)="AND"
 660 LET G$(4)="BUT"
 665 LET G$(5)="OR"
 670 LET G$(6)="AS"
 675 LET G$(7)="FOR"
 680 LET G$(8)="SO"
 685 LET G$(9)="YET"
 690 LET G$(10)="HOW"
 695 REM ****POEM GENERATOR**:
 700 PRINT AT 4,0;E$
 705 FOR X=0 TO LEN E$-1
 710 PRINT AT 5,X;"_"
 715 NEXT X
 720 FOR Y=6 TO 17 STEP 4
 725 GOSUB 940
 730 PRINT AT Y,0;"  ";B$(B, TO
I);", ";B$(B, TO I);" ";A$(A, TO
H);" ";C$(C, TO J);","
 735 GOSUB 940
 740 PRINT AT Y+1,0;" ";F$(F, TO
L);" ";B$(B, TO I);" ";A$(A, TO
H);" ";C$(C, TO J);","
 745 GOSUB 940
 750 PRINT AT Y+2,0;G$(G, TO M);
" ";B$(B, TO I);" ";A$(A, TO H);
" ";C$(C, TO J);" ";D$(D, TO K);
"."
 755 GOSUB 940
 760 PRINT AT Y+3,0;G$(G, TO M);
" ";B$(B, TO I);" ";A$(A, TO H);
" ";C$(C, TO J);" ";D$(D, TO K);
"."
 765 NEXT Y
 770 PRINT AT 20,0;"WOULD YOU LI
KE A PRINTOUT?      ENTER ""Y""-
YES OR ""N""-NO."
 775 INPUT 0$
 780 IF 0$="N" THEN GOTO 795
 785 IF 0$="Y" THEN GOSUB 1070
 790 IF 0$<>"Y" THEN GOTO 775
 795 PRINT AT 20,0;"ANOTHER POEM
 WITH THE SAME     WORDS? ENTER
 ""Y""-YES OR ""N""-NO."
 800 INPUT 0$
 805 IF 0$="Y" THEN GOTO 530
 810 IF 0$<>"N" THEN GOTO 800
 815 PRINT AT 20,0;"WANT TO WRIT
E ANOTHER POEM?     ENTER ""Y""-
YES OR ""N""-NO,
                "
 820 INPUT 0$
 825 IF 0$="Y" THEN GOTO 80
 830 IF 0$="N" THEN GOTO 1090
 835 IF 0$<>"N" THEN GOTO 820
 840 REM **********************
 845 FOR Y=4 TO 21
 850 PRINT AT Y,0;"
                "
 855 NEXT Y
 860 RETURN
 865 REM **********************
 870 LET X=5
 875 LET N=1
 880 FOR Y=11 TO 15
 885 PRINT AT Y,10;N;"."
 890 LET N=N+1
 895 NEXT Y
 900 RETURN
 905 REM **********************
 910 PRINT AT 20,0;"ENTER WORD N
UMBER ";CT;"      "
 915 RETURN
 920 REM **********************
 925 PRINT AT 20,0;"IS THE ENTRY
 CORRECT?            ENTER ""Y""-
YES OR ""N""-NO,  "
 930 RETURN
 935 REM **********************
 940 LET A=INT  (RND*5)+1
 945 LET B=INT  (RND*5)+1
 950 LET C=INT  (RND*5)+1
 955 LET D=INT  (RND*5)+1
 960 LET F=INT  (RND*10)+1
 965 LET G=INT  (RND*10)+1
 970 FOR H=LEN A$(A) TO 1 STEP -1
 975 IF A$(A,H)<>" " THEN GOTO 9
85
 980 NEXT H
 985 FOR I=LEN B$(B) TO 1 STEP -1
 990 IF B$(B,I)<>" " THEN GOTO 1
000
 995 NEXT I
1000 FOR J=LEN C$(C) TO 1 STEP -1
1005 IF C$(C,J)<>" " THEN GOTO 1
015
1010 NEXT J
1015 FOR K=LEN D$(D) TO 1 STEP -1
1020 IF D$(D,K)<>" " THEN GOTO 1
030
1025 NEXT K
1030 FOR L=LEN F$(F) TO 1 STEP -1
1035 IF F$(F,L)<>" " THEN GOTO 1
045
1040 NEXT L
1045 FOR M=LEN G$(G) TO 1 STEP -1
1050 IF G$(G,M)<>" " THEN RETURN
1055 NEXT M
1060 RETURN
1065 REM **********************
1070 PRINT AT 20,0;"
                "
1075 COPY
1080 RETURN
1085 REM **********************
1090 CLS
1095 PRINT AT 9,11;"SOREHEAD."
1100 FOR L=1 TO 50
1105 NEXT L
1110 NEW
```

VIDEO GRAPHITY



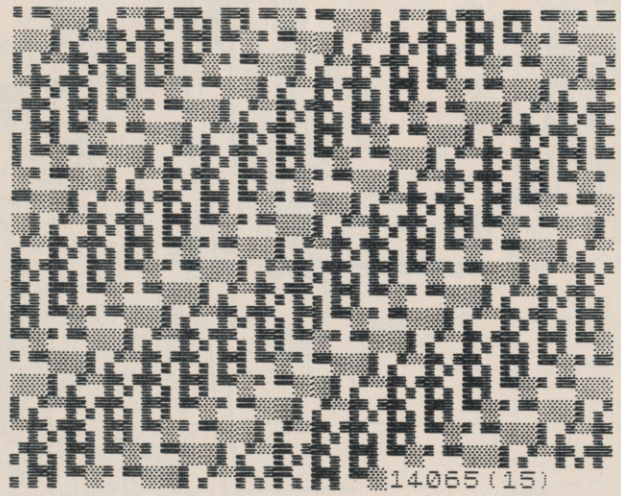
THIS is a game that allows you to draw a picture with the cursor. To erase something (move the cursor without leaving a trail), press E, and to draw again, press R. When you are finished, type A. To retrieve a picture previously loaded onto the cassette, type Y.

Submitted by Alex R. San Miguel of Tenafly, N.J.
(T/S1000,1500,ZX81 16K).

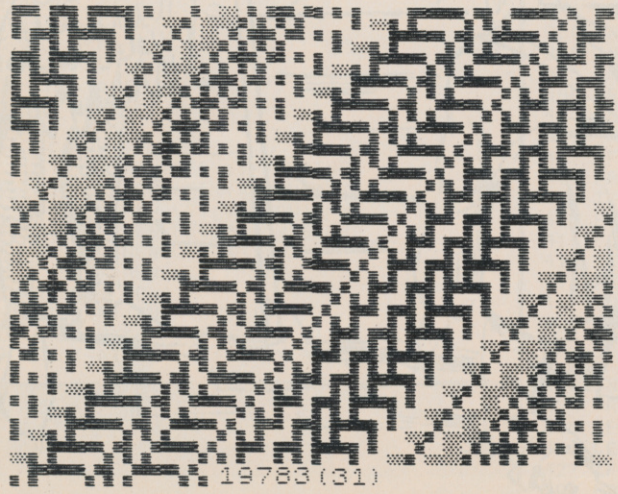
```
   1 PRINT AT 10,9;"VIDEO GRAPHI
TY"
   2 PAUSE 200
   3 PRINT "THE FOLLOWING NUMBER
S MOVE THE  PIXEL TO DRAW:1.UP L
EFT 2.DOWN  LEFT 3.DOWN RIGHT 4.
UP RIGHT    5.LEFT 6.DOWN 7.UP 8
.RIGHT"
   4 PRINT "TYPE E TO ERASE OR M
OVE PIXEL   WITHOUT DRAWING, TYP
E R TO DRAW AGAIN, TYPE A TO STO
P "
   5 PRINT AT 21,0;"(PRESS ANY K
EY)"
   6 PAUSE 40000
   8 PRINT AT 21,0;"DO YOU WANT
LAST DRAWING?"
   9 INPUT L$
  10 IF L$="Y" THEN GOTO 199
  11 CLS
  12 DIM F(63,42)
  13 LET X=31
  14 LET Y=21
  15 LET S=16
  16 UNPLOT X,Y
  17 PLOT X,Y
  20 IF INKEY$="5" THEN LET X=X-1
  25 IF INKEY$="1" THEN LET X=X-1
  26 IF INKEY$="1" THEN LET Y=Y+1
  30 IF INKEY$="6" THEN LET Y=Y-1
  35 IF INKEY$="4" THEN LET Y=Y+1
  36 IF INKEY$="4" THEN LET X=X+1
  40 IF INKEY$="8" THEN LET X=X+1
  45 IF INKEY$="3" THEN LET X=X+1
  46 IF INKEY$="3" THEN LET Y=Y-1
  50 IF INKEY$="7" THEN LET Y=Y+1
  55 IF INKEY$="2" THEN LET Y=Y-1
  56 IF INKEY$="2" THEN LET X=X-1
  60 IF S=100 THEN LET F(X,Y)=0
  65 IF S=16 THEN LET F(X,Y)=1
  70 IF INKEY$="R" THEN LET S=16
  75 IF INKEY$="E" THEN LET S=100
  80 IF INKEY$="A" THEN GOTO 150
  85 GOTO S
 100 PLOT X,Y
 101 UNPLOT X,Y
 102 GOTO 20
 150 CLS
 151 PRINT "DO YOU WANT TO SAVE?"
 152 INPUT L$
 153 IF L$="Y" THEN GOTO 156
 154 CLS
 155 STOP
 156 PRINT "SET UP RECORDER"
 157 PAUSE 240
 158 PRINT "START RECORDER"
 159 PAUSE 120
 160 SAVE "VIDEO GRAPHITY"
 161 PRINT "DRAWING SAVED"
 162 STOP
 199 CLS
 200 FOR X=1 TO 63
 201 FOR Y=1 TO 42
 202 IF F(X,Y)=1 THEN PLOT X,Y
 203 NEXT Y
 204 NEXT X
 205 GOTO 13
```

UNIVERSAL PATTERNER

```
  10 DIM A(33)
  15 SLOW
  20 PRINT "RANDOM PATTERN? (Y O
R N)"
  30 INPUT A$
  40 CLS
  50 IF NOT  A$="Y" THEN GOTO 20
0
  60 LET L=INT  (RND*33)+1
  70 LET X=INT  (RND*65535)+1
  80 RAND X
  85 FAST
  90 FOR J=1 TO L
 100 LET A(J)=INT  (RND*10)+1
 110 NEXT J
 120 FOR J=1 TO 660/L
 130 FOR K=1 TO L
 140 PRINT CHR$ A(K);
 150 NEXT K
 160 NEXT J
 170 PRINT X;"(";L;")"
 180 STOP
 200 PRINT "PATTERN NUMBER?"
 210 INPUT X
 220 CLS
 230 PRINT "STRING LENGTH?"
 240 INPUT L
 250 CLS
 260 GOTO 80
```



14065(15)



19783(31)

UNIVERSAL PATTERNER is for 16K users and produces patterns at random. Author W.S. Hearn states that more than two million designs can be printed on the screen.

Each pattern has a number and string length printed at the bottom, so can be recalled and adjusted using those numbers. Answer N for No when asked if a random pattern is required and then input the numbers.

Kingdom

FIVE-YEAR PLANS, monetarism, the green revolution, laissez faire and the dictatorship of the people — you can try them all.

Kingdom gives you a rural realm to regulate and five years in which to increase your personal wealth and protect your people against flood, famine and the depredations of the ruthless local banditry.

You are first given instructions for the game and asked to input your name, age and sex. Depending on the information you supply, you will be dubbed king, queen, prince or princess and then asked to decide how best to divide your available workforce in the season ahead. Consider the crops, or your subjects will starve. Bear the bandits in mind or your minions are murdered. Delay on the dykes and they will drown.

It is reasonably difficult. Our 1,000 subjects were reduced to single figures after the first year.

Any number can play and you have five years in which to justify

your kingship and to amass as much money as possible by the judicious selling of surplus grain.

Good luck, your highness, and thanks to Andrew Johnson, who submitted this excellent listing (T/S1000,ZX81).

```
 1 PRINT AT 3,7;"******************"
 2 PRINT AT 4,7;"*                *"
 3 PRINT AT 5,7;"* K I N G D O M *"
 4 PRINT AT 6,7;"*                *"
 5 PRINT AT 7,7;"******************"
 6 PRINT AT 10,0; "  YOU HAVE TO GOVERN A VILLAGE";
   AT 12,0; "FOR A PERIOD OF FIVE YEARS.YOU"; AT 14,0;
   "MUST TRY TO KEEP ALIVE AS MANY"
 7 PRINT AT 16,0; "PEOPLE AS POSSIBLE,THEY WILL DO";
   AT 18,0; "ONE OF THREE JOBS."; AT 20,0;
   "YOU MUST PROTECT THEM AGAINST.."
 8 PRINT AT 21,5; "TYPE ANY KEY TO CONT."
 9 IF INKEY$="" THEN GOTO 9
10 FOR F=10 TO 21
11 PRINT AT F,0; "                                "
12 NEXT F
13 PRINT AT 10,0; "...(A)=>FLOODS"; AT 11,0;
   "...(B)=>STARVATION"; AT 12,0; "...(C)=>THEIVES";
   AT 14,0; "YOU HAVE TO BE AS RICH AS POSS."; AT 16,0;
   "AT THE END OF THE FIVE YEARS"; AT 18,0;
   "AND THE RICHEST WINS."
14 PRINT AT 21,5; "TYPE ANY KEY TO CONT."
15 IF INKEY$="" THEN GOTO 15
16 FOR F=10 TO 21
17 PRINT AT F,0; "                                "
18 NEXT F
19 PRINT AT 10,0; "HOW MANY PLAYERS?  ";
20 INPUT A
21 PRINT A
22 DIM N$(A,11)
23 DIM U(A)
24 GOSUB 7000
34 PRINT AT 21,5; "TYPE ANY KEY TO START"
35 IF INKEY$="" THEN GOTO 35
36 FOR F=1 TO 22
37 SCROLL
38 NEXT F
39 GOSUB 8000
40 DIM M(A)
41 DIM C(A)
42 DIM Q(A)
43 FOR F=1 TO A
44 LET M(F)=1000
45 LET Q(F)=1000
46 LET C(F)=2500
47 NEXT F
48 DIM D(A)
49 DIM N(A)
50 DIM Z(A)
51 DIM X(A)
52 DIM T(A)
53 FOR F=1 TO A
54 LET Z(F)=0
55 LET X(F)=0
56 LET T(F)=0
57 NEXT F
100 REM start
105 LET S=0
110 LET Y=0
115 LET S=S+1
120 IF S=1 THEN LET Y$="SPRING"
125 IF S=2 THEN LET Y$="SUMMER"
130 IF S=3 THEN LET Y$="AUTUMN"
135 IF S=4 THEN LET Y$="WINTER"
140 IF S=1 THEN LET Y=Y+1
150 IF S=4 THEN LET S=0
170 FOR P=1 TO A
175 LET N(P)=INT (RND*10)
176 LET Q(P)=Q(P)+N(P)
180 PRINT AT 0,9; Y$; " YEAR "; Y
```

```
190 IF N$(P)(11) = "M" AND U(P) > 18 THEN PRINT "KING ";
    N$(P)( TO 10)
193 IF N$(P)(11) = "F" AND U(P) <= 18 THEN PRINT
    "PRINCESS "; N$(P)( TO 10)
195 IF N$(P)(11) = "M" AND U(P) <= 18 THEN PRINT
    "PRINCE "; N$(P)( TO 10)
200 IF N$(P)(11) = "F" AND U(P) > 18 THEN PRINT "QUEEN ";
    N$(P)( TO 10)
201 PRINT
202 PRINT N(P); " PEOPLE CAME TO THE VILLAGE."
203 PRINT
210 PRINT TAB 9; "CASUALTIES:"
211 PRINT " STARVED . FLOODS . THIEVES"
212 PRINT TAB 3; X(P); TAB 12; Z(P); TAB 22; T(P)
214 PRINT "**********************************"
220 PRINT TAB 10; "YOU HAVE:"
240 PRINT TAB 15-(((LEN (STR$ M(P)))+2)/2); "$"; M(P); ","
260 PRINT TAB 15-(((LEN (STR$ Q(P)))+8)/2); Q(P);
    " PEOPLE,"
280 PRINT TAB 15-(((LEN (STR$ C(P)))+15)/2);
    "SACKS OF CORN."
290 PRINT "**********************************"
300 PRINT "LABOR  ARRANGEMENT:"
320 PRINT "(A) MENDING THE DYKE ";
330 INPUT A1
335 IF INT A1 <> A1 THEN GOTO 330
340 PRINT A1
360 PRINT "(B) PLANTING CORN "
370 INPUT A2
375 IF INT A2 <> A2 THEN GOTO 370
380 PRINT A2
400 PRINT "(C) DEFENDING THE VILLAGE "
409 INPUT A3
410 IF INT A3 <> A3 THEN GOTO 409
411 PRINT A3
412 IF A1+A2+A3 <= Q(P) THEN GOTO 420
413 PRINT AT 21,5; "TOO MANY PEOPLE"
414 FOR F=1 TO 22
415 IF INT A3 <> A3 THEN GOTO 410
416 NEXT F
417 GOTO 180
420 IF Y$ <> "SPRING" THEN GOTO 430
422 PRINT "HOW MANY SACKS OF CORN ARE TO";
    "    BE PLANTED?  ";
423 INPUT D(P)
424 PRINT D(P)
425 IF D(P) > C(P) THEN GOTO 422
426 LET C(P) = C(P)-D(P)
427 IF D(P)/10 > A2 THEN LET D(P)=A2*10
430 PRINT AT 21,5; "TYPE ANY KEY TO CONT."
440 IF INKEY$="" THEN GOTO 440
```

Kingdom Revisited

Note: *This program, missing about a dozen lines, first ran in Issue 3. It has now been corrected. Our thanks to the many readers who brought the error to our attention.*

```
 450 FOR F=1 TO 22
 460 SCROLL
 465 NEXT F
 466 FAST
 470 PRINT AT 0,0; M$
 490 PRINT AT 8,14; "******"; AT 9,14; "*    *"; AT 10,14;
     "* ++ *"; AT 11,14; "*    *"; AT 12,14; "******"
 500 PRINT AT 10,27; "T"
 501 LET T(P)=0
 502 LET Z(P)=0
 503 LET X(P)=0
 504 SLOW
 510 IF A1 < Q(P)/2.2 THEN GOSUB 1000
 520 IF A3 < Q(P)/2.2 THEN GOSUB 2000
 530 IF D(P) < Q(P)*2 THEN GOSUB 3000
 535 LET C(P) = (C(P)/1.2) + D(P)*3
 540 IF C(P)+D(P) < Q(P)*2 THEN GOSUB 4000
 550 IF C(P)+D(P) > Q(P)*2 THEN GOSUB 5000
 560 LET Q(P)=Q(P)*1.2
 565 LET Q(P)=INT (Q(P))
 575 LET C(P)=INT (C(P))
 580 LET M(P)=M(P)*1.09
 583 LET M(P)=INT (M(P))
 590 FOR F=1 TO 22
 600 SCROLL
 610 NEXT F
 611 IF M(P) < 0 THEN LET M(P)=0
 612 IF C(P) < 0 THEN LET C(P)=0
 613 IF Q(P) < 0 THEN LET Q(P)=0
 620 NEXT P
 630 IF Y < 5 THEN GOTO 115
 640 PRINT AT 0,0; "NOW FOR THE WINNER....."
 644 LET W$=""
 645 LET W=0
 650 FOR F=1 TO A
 660 PRINT N$(F)( TO 10); " WITH $"; M(F); ","
 680 IF M(F)>W THEN LET W$=N$(F)
( TO 10)
 690 IF M(F)>W THEN LET W=M(F)
 700 NEXT F
 705 POKE 16418,0
 710 PRINT AT 20,0,"CONGRATULATI
ONS",W$;"       YOU ARE THE WINNE
R OF THE GAME  WITH $";W
 730 GOTO 10000
1000 REM DYKE
1010 IF INT (RND*3)+1=1 THEN RET
URN
1020 LET K=INT (RND*10)+5
1030 FOR F=3 TO K+3
1040 FOR G=0 TO 21
1050 PRINT AT G,F;CHR$ 8
1060 NEXT G
1070 IF K*10>Q(P) THEN LET K=INT
 (Q(P)/10)
1080 LET Q(P)=Q(P)-K*10
1090 IF K>8 THEN LET M(P)=M(P)-(
(K-8)*100)
1095 LET Z(P)=K*10
1100 LET C(P)=C(P)-K*15
1110 RETURN
2000 REM DEF
2010 IF INT (RND*3)+1=1 THEN RET
URN
2020 LET K=INT (RND *10) + 5
2025 IF K*6 > Q(P) THEN LET K=INT (Q(P)/6)
2030 FOR F=27 TO 16 STEP -1
2040 PRINT AT 10,F; "T "
2050 NEXT F
2060 FOR F=1 TO K
2070 PRINT AT 10,16; "(graphic 4)"
2080 PRINT AT 10,16; "(graphic 1)"
2090 PRINT AT 10,16; "(graphic 2)"
2100 PRINT AT 10,16; "(graphic 3)"
2110 NEXT F
2120 FOR F=16 TO 27
2130 PRINT AT 10,F; " T"
2140 NEXT F
2150 LET Q(P) = Q(P)-K*6
2151 LET T(P) = K*6
2160 LET C(P) = C(P)-K*25
2170 LET M(P) = M(P)-K*15
2180 RETURN
3000 REM STAR
3010 LET K = ABS (D(P)-(Q(P)*2))
3015 IF K > Q(P) THEN LET K=Q(P)
3020 LET Q(P) = Q(P)-(INT (K))
3035 LET X(P)=K
3040 RETURN
```

```
4000 REM BUY
4010 LET K=INT (RND*5)+15
4020 FOR F=1 TO 22
4030 SCROLL
4040 NEXT F
4050 PRINT AT 0,0; "YOU HAVEN'T GOT ENOUGH CORN  TO FEED ";
     "YOUR VILLAGE-YOU MUST BUY  SOME..."
4060 PRINT
4070 PRINT "CURRENT BUYING RATE = ";K
4080 PRINT
4090 PRINT "YOU HAVE $"; M(P)
4100 PRINT
4110 PRINT "THE MOST YOU CAN HAVE ARE "; INT (M(P)/K)
4120 PRINT "SACKS"
4140 PRINT "HOW MANY DO YOU WANT TO BUY?";
4150 INPUT I
4160 IF I > (M(P)/K) THEN GOTO 4140
4170 PRINT I
4180 PRINT
4190 PRINT "THAT WILL COST $"; I*K
4200 LET M(P) = M(P)-(K*I)
4210 LET C(P) = C(P)+1
4220 RETURN
5000 REM SELL
5010 FOR F=1 TO 22
5020 SCROLL
5030 NEXT F
5040 PRINT AT 0,0; "YOU HAVE A SURPLUS OF CORN,DO   YOU";
     "WANT TO SELL ANY, IF SO       SPECIFY THE AMOUNT."
5050 INPUT A$
5060 IF A$(1)="N" THEN RETURN
5070 LET K=VAL A$
5071 IF K <= C(P) THEN GOTO 5080
5072 PRINT
5073 PRINT "YOU ONLY HAVE "; INT (C(P)); " SACKS."
5074 IF INKEY$="" THEN GOTO 5074
5075 GOTO 5000
5080 LET J = INT (RND*5)+5
5090 PRINT K; " SACKS OF CORN,AT"
5100 PRINT "$";J; " A SACK,WILL MAKE "
5110 PRINT "$"; K*J
5120 LET M(P) = M(P)+K*J
5130 LET C(P) = C(P)-K
5140 RETURN
7000 FOR F=1 TO A
7010 CLS
7020 PRINT "PLAYER ";F
7030 PRINT
7040 PRINT "YOUR NAME PLEASE:   "
7050 INPUT N$(F)
7051 PRINT N$(F)
7052 PRINT
7060 PRINT "YOUR AGE(APROX)? ";
7070 INPUT U(F)
7080 PRINT U(F)
7090 PRINT
7100 PRINT "ARE YOU MALE(M)/FEMALE(F)? ";
7110 INPUT N$(F)(11)
7120 PRINT N$(F)(11)
7130 PRINT
7140 PRINT "O.K.? ";
7150 INPUT H$
7160 PRINT H$
7170 IF H$="NO" OR H$="N" THEN GOTO 7010
7180 NEXT F
7190 RETURN
8000 FAST
8005 LET M$=""
8010 FOR F=1 TO 22
8020 LET M$ = M$ + "(three graphic As;inverse SPACE;
     twenty two SPACEs;six /s)"
8030 NEXT F
8040 SLOW
8050 RETURN
9000 SAVE "KINGDOM"
9010 RUN
```

TREASURE HUNTER

TREASURE HUNTER is a clever little game in which a hunter, denoted by an asterisk, has to find treasure which is hidden at a random position on the screen. The only assistance given to the hunter is that he is told when he is getting warmer.

It can be very annoying when, whichever way you move, you seem to be getting warmer but cannot find the exact location of the treasure. When the correct spot is found, the number of steps taken is shown on the screen, along with the program's idea of the optimum number.

The first attempt by the *Timex Sinclair User*'s reviewer resulted in 453 steps taken against an optimum of five. That later improved to 84 against an optimum of 30.

The hunter is moved by using the cursor keys but an added difficulty is that if you go to the edge of the screen you bounce back so that the left and right keys and the up and down keys become reversed.

Treasure Hunter was sent by P. Brown.

```
  10 REM TREASURE HUNT BY P AND
A BROWN
  20 LET P=PI/PI
  30 LET Q=PI-PI
  40 LET L=INT (RND*VAL  "15")+V
AL "2"
  50 LET C=INT (RND*VAL  "27")+
VAL "2"
  60 LET S=Q
  70 LET OP=P
  80 LET OQ=Q
  90 LET P=P+(INKEY$="6")-(INKEY
$="7")
 100 LET Q=Q+(INKEY$="8")-(INKEY
$="5")
 110 CLS
 120 PRINT AT P,Q;"*"
 130 LET S=S+PI/PI
 140 IF P=L AND Q=C THEN GOTO VA
L "210"
 150 LET D=L-P
 160 LET E=C-Q
 170 LET F=L-OP
 180 LET G=C-OQ
 190 IF ABS D+ABS E<ABS F+ABS G
THEN PRINT AT 0,0;"WARMER"
 200 GOTO VAL "70"
 210 PRINT AT L,C;"X"
 220 PRINT "LOOT FOUND IN";S;"ST
EPS"
 230 PRINT "OPTIMUM";L+C-VAL "1"
```

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Hardware

Screen monitor saves eyesight

The Gorilla seems to have done it . . . an under $100 monitor for the under $100 computer. The high-resolution, green screen, non-glare monitor is selling for $99.

The non-glare screen not only makes long-term viewing easier on your eyes, it also eliminates annoying reflections. Special phosphors switch fast but flow evenly to prevent screen flicker and the eyestrain that goes with it. Those same phosphors stop scrolling characters or fast flying spaceships from appearing smeared or streaky.

The crisp screen displays at a video band width of 18 MHz or better a full 25 lines of 80 characters each (2,000 characters). The sharpness of the display enhances graphics on the screen also.

We liked the built-in tilt bracket. Using it, we could angle the monitor for our best viewing.

Technical Summary

* 12-in. high-resolution phosphorous tube
* non-glare screen and medium-fast (p. 31) phosphorous persistence
* video band width of 18 MHz to 22MHz
* 80 × 25 character display
* weighs 14 pounds
* 25W at 120V
* 75 ohm negative sync composite video signal input
* 11.9-in. h × 13.6-in. w × 11.8-in. d
* suggested retail price of $79

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or circle 37 on the reader service card.

Device Delivers

Last month we reviewed a SAVE/LOAD device designed to ensure clean, dependable and accurate loading and saving of data. L-Monitor (the company's and the device's name) quickly pointed out to us that their add-on does the same.

The L-Monitor features an easy-to-read microammeter that shows the level of the recording while loading or saving. This meter also allows the user to adjust the L-Monitor to work with just about any tape recorder.

The earphone plug lets you listen in to the LOAD, thus making it unnecessary to unplug the recorder to hear starting instructions that may be on the tape. The L-Monitor can also be used for aligning the heads on your tape recorder (a problem that will often cause you great frustration when you try to load a program previously saved). The device comes with complete and simple instructions as well as all necessary cables.

improves graphics,

THE GORILLA HI-RES GREEN SCREEN MONITOR.
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USES

1. cleaner, surer loads
2. better saves
3. program duplication while loading
4. alignment of tape recorder heads
5. balancing the tape recorder tone and volume for optimum use

FEATURES

1. easy to read meters monitor both save and load levels
2. earphone plug for listening or for attaching to an outside amplifier
3. plugs into jacks on the computer so the rear socket remains available
4. is user-adjustable to match your tape recorder
5. simple to use

COST

Assembled (and tested) $23.50
Kit $17.50

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News

U.K. Aids the Handicapped

A series of Microfairs in the U.K. are being held with a real difference. These fairs are set up to show what is being done in the field of microelectronics to help the disabled.

They are called Electronic Aids for the Handicapped and are set up as mobile units to enable them to travel across the country.

Timex Speeds Up

Delivery of the long-awaited T/S2000 series is being moved up by Timex. Demand by dealers and the public for the new series of machines has created pressures to which Timex is trying to respond.

Originally scheduled as two machines, the T/S2048 and the T/S2072, Timex has changed this to a single machine, the T/S2068, in an attempt to increase its ability to put new computers on the store shelves faster. The T/S1000 appears to have lost public appeal and Timex is working quickly to replace it with new computers.

The increase in demand for the T/S2068 has, it appears, not changed the corporation's decision to also produce the T/S1500, an updated version of the T/S1000. Market analysts agree that it is imperative for Timex to get onto the market with its new machine quickly if it wants to maintain its preeminence in the personal home computer field.

And Now the Comics

ECC Publications, the parent company of *Timex Sinclair User* magazine has come out with another winner, LOAD RUNNER, which it calls "the Galaxy's First Computer Comic." Aimed at nine to 18 year olds, each comic book presents a series of stories, puzzles and news items on such things as computer information and competitions.

This comic is not Timex Sinclair specific and in fact

covers just about every computer available for personal home use. The reader is treated to the adventures of LOAD RUNNER, the comic fun of ROM and RAM, computer crossword puzzles and new stories every two weeks.

The cost per issue is about 75 cents. It is currently available only in the U.K.

Ø/Ø

Feature

Kwikplot: A program for investigating correlations

Jim Tankard modernizes and computerizes a technique devised by British mathematicians in the 19th century

ONE OF THE USEFUL techniques of statistics is to look at the relationship — or correlation — between two variables. The "variables" are simply any quantities that vary — gross national product and literacy rates, murder rate and number of executions, hours spent in exercise and cholesterol levels, and so on.

The technical name for the measure of these kinds of relationships is the correlation coefficient. This technique was invented by Sir Francis Galton, a British scientist who was looking at the relationships between the heights of parents and their children as a means of discovering the laws of heredity. Karl Pearson, the great British statistician, realized that it was a general measure that could be used to investigate many kinds of relationships, and developed a

The Kwikplot Program

```
  10 REM "KWIKPLOT"
  20 DIM A$(17,25)
  30 LET MX=0
  40 LET MY=0
  50 LET CROSS=0
  60 LET MSQX=0
  70 LET MSQY=0
  80 DIM X(100)
  90 DIM Y(100)
 100 PRINT AT 10,0;"INPUT YOUR S
AMPLE SIZE."
 110 INPUT N
 120 CLS
 130 PRINT AT 10,0;"INPUT YOUR D
ATA WITH EACH X FOLLOWED BY ITS
Y."
 140 FOR I=1 TO N
 150 INPUT X(I)
 160 INPUT Y(I)
 170 CLS
 180 NEXT I
 190 FOR I=1 TO N
 200 LET MX=MX+X(I)
 210 LET MY=MY+Y(I)
 220 LET CROSS=CROSS+X(I)*Y(I)
 230 LET MSQX=MSQX+(ABS X(I))**2
 240 LET MSQY=MSQY+(ABS Y(I))**2
 250 NEXT I
 260 LET MX=MX/N
 270 LET MY=MY/N
 280 LET SX=SQR ((MSQX/N)-(MX)**
2)
 290 LET SY=SQR ((MSQY/N)-(MY)**
2)
 300 IF SX=0 OR SY=0 THEN GOTO 3
30
 310 LET R=((CROSS/N)-(MX*MY))/(
SX*SY)
 320 PRINT "MX=";MX;" MY=";MY;"
R=";R
 330 IF SX=0 OR SY=0 THEN PRINT
"R IS NOT COMPUTABLE"
 340 PRINT
 350 LET XH=X(1)
 360 LET YH=Y(1)
 370 FOR I=1 TO N
 380 IF X(I)>XH THEN LET XH=X(I)
 390 IF Y(I)>YH THEN LET YH=Y(I)
 400 NEXT I
 410 LET XRANGE=XH
 420 LET YRANGE=YH
 430 LET IX=XRANGE/16
 440 LET P=YRANGE/4
 450 LET Z=XH
 460 FOR I=1 TO N
 470 LET X(I)=INT (((X(I)/XRANGE
)*16)+1.5)
 480 LET Y(I)=INT (((Y(I)/YRANGE
)*24)+1.5)
 490 NEXT I
 500 FOR I=1 TO 17
 510 FOR J=1 TO 24
 520 LET A$(I,J)=" "
 530 NEXT J
 540 NEXT I
 550 FOR I=1 TO N
 560 IF A$(X(I),Y(I))="8" THEN L
ET A$(X(I),Y(I))="9"
 570 IF A$(X(I),Y(I))="7" THEN L
ET A$(X(I),Y(I))="8"
 580 IF A$(X(I),Y(I))="6" THEN L
ET A$(X(I),Y(I))="7"
 590 IF A$(X(I),Y(I))="5" THEN L
ET A$(X(I),Y(I))="6"
 600 IF A$(X(I),Y(I))="4" THEN L
ET A$(X(I),Y(I))="5"
 610 IF A$(X(I),Y(I))="3" THEN L
ET A$(X(I),Y(I))="4"
 620 IF A$(X(I),Y(I))="2" THEN L
ET A$(X(I),Y(I))="3"
 630 IF A$(X(I),Y(I))="*" THEN L
ET A$(X(I),Y(I))="2"
 640 IF A$(X(I),Y(I))=" " THEN L
ET A$(X(I),Y(I))="*"
 650 NEXT I
 660 FOR I=17 TO 1 STEP -1
 670 IF I=1 THEN PRINT "0";TAB 4
;"▮";A$(I)
 680 IF I>1 THEN PRINT INT (Z+.5
);TAB 4;"▮";A$(I)
 690 LET Z=Z-IX
 700 NEXT I
 710 PRINT TAB 4;"▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬▬"
 720 PRINT TAB 5,0,TAB 10,INT ((
YRANGE-3*P)+.5);TAB 16;INT ((YRA
NGE-2*P)+.5);TAB 22;INT ((YRANGE
-P)+.5);TAB 28;INT (YRANGE)
```

formula for it. The correlation coefficient gives a numerical measure of the strength of the relationship between two variables, or varying quantities. The coefficient can range from +1.0 for a perfect positive relationship to −1.0 for a perfect negative relationship. A correlation of or near 0 means that there is no relationship, or that one variable cannot be predicted from the other.

When you are computing a correlation coefficient, it is also often useful to look at a graph or *scatterplot* of the relationship between the two variables. A scatterplot represents one variable on a vertical axis and the other on a horizontal axis, and contains points providing a visual illustration of the relationship. The more the points tend to form a straight line, the stronger the relationship.

I developed a program called KWIKPLOT to construct a scatterplot and compute a correlation coefficient using the T/S1000 ZX81. This program also computes a mean or average for each variable, since this was easy to include with the other computations and it can help in understanding data. These tasks are easily performed by program packages such as SPSS (*Statistical Package for the Social Sciences*) available on large university computers. But it was a bit more of a challenge to do it with the T/S1000 ZX81.

The correlation coefficient ranges from −1 to +1

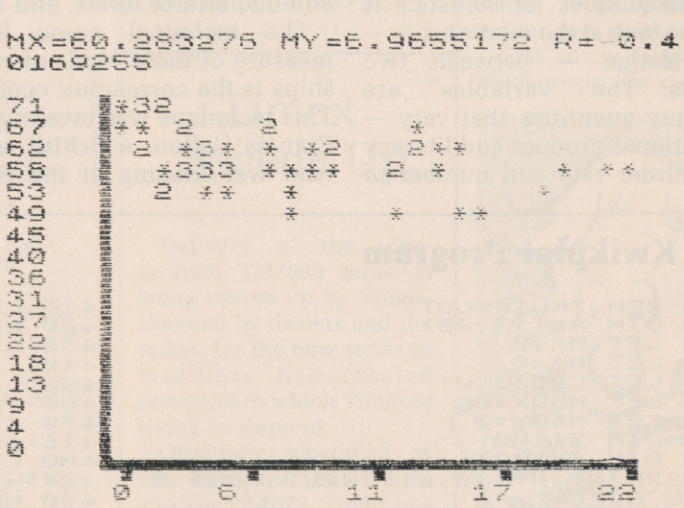
Data are input into Kwikplot with lines 100 to 160. The sample size is the number of *pairs* of observations, with each pair being made up of something like the height and weight from one case or individual. The correlation coefficient, along with the means of each of the two variables, is computed in lines 180 to 310 and printed in line 320. The range for each variable is found in lines 350 to 420. The ranges are necessary so the computer can label each axis with a scale of appropriate values. Lines 430 to 450 determine the values that will be printed in those scales. Lines 460 to 490 convert the original values of the X and Y variables to units that can be graphed on the screen. Lines 500 to 540 create a large array with 17 rows and 24 columns that corresponds to the 17 by 24 character portion of the screen where points will be graphed. These lines also fill the array with blanks. Lines 550 to 650 put an asterisk (*) in the array at the appropriate place for every point to be printed. If an asterisk is already there, these lines assign a 2, and so on. Lines 660 to 700 print the labels for the scale for the X-axis, the line making up the X-axis, and the points in the scatterplot. Line 710 prints the Y-axis. Line 720 prints the labels for the scale for the Y-axis.

Galton compared heights of parents and children

The program uses variable names that are longer than one letter to help the user understand what is happening at various places. For instance, CROSS is the cross-product that is a basic part of the computation of a correlation coefficient, and XRANGE is the range of values taken by X.

An example of output is shown in Figure 1. The X-axis (vertical in this case) lists final grades in a communication theory class, with the highest possible score being 75 points. The Y-axis (horizontal in this case) lists number of absences during the semester. The lines at the top print the mean of X (MX), the mean of Y (MY), and the correlation coefficient (R). In this example, there is a moderate negative correlation of −.40 between the two variables. This correlation suggests that high numbers of absences are related to low grades, and vice versa. However, the fact that the correlation is moderate rather than strong suggests that attendance is not the only variable affecting grades. Other factors that might also influence grades are time spent reading the textbook, skill in taking notes while attending class, and time spent going over notes before a test.

Figure 1. *Student grades* versus *absences from class.*



A second example is shown in Figure 2. The X axis (vertical) is gas consumption in a residence measured in thousand cubic feet. The Y axis (horizontal) is a time dimension, with the numbers 1 to 24 standing for a 24-month period beginning in January. The correlation coefficient is probably not very meaningful here since the numerical values assigned to the months were arbitrary and not really measuring anything. The scatterplot shows that the relationship between gas consumption and time of the year has a great deal of regularity or lawfulness. In this case, we know that the regularity is caused by some very lawful changes in temperature as the seasons change. But in other cases that we might not understand so well, a scatterplot of this type could help us to discover new types of regularities, or laws.

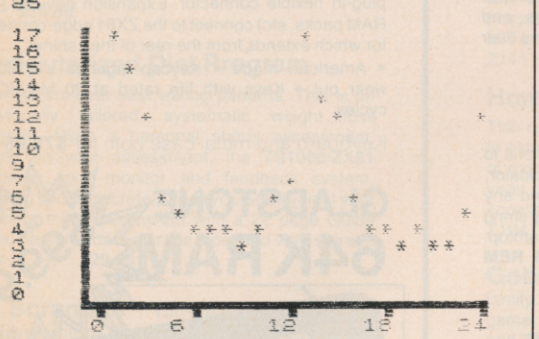


Figure 2. *Gas consumption (vertical) versus time in months.*

KWIKPLOT has limitations. With certain types of numbers — those that are more than four digits, negative numbers, or numbers between 0 and 1 — the scatterplot will not be printed or will be misleading, although the correlation coefficient and means will be correct. Also, if either X or Y has no variation, you will get a scatterplot but there will be a message saying that the correlation coefficient cannot be computed.

The program has several features that are standard for large computer program packages but that might be unusual for small computers such as the T/S1000, ZX81. It labels the X and Y axes in an easily readable fashion, and these scales change according to the value of each data set. And, as mentioned before, if more than one observation occurs at the same point, the program prints a number on the screen instead of an asterisk to show the number of cases there.

Also, KWIKPLOT is fast. You can bet that Francis Galton and Karl Pearson didn't have anything like it when they computed the first correlation coefficients 100 years ago!

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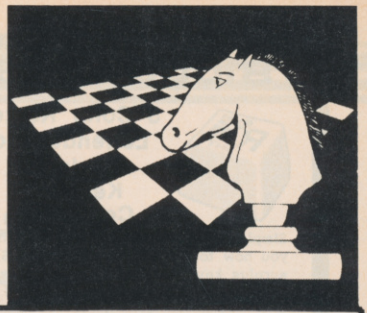

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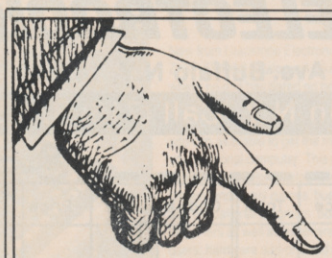

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Letters

continued from page 10

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INVERSE VIDEO CHARACTERS

I just bought the first copy of your magazine and am very impressed. The many different departments with good articles and ideas are appreciated. I have only one suggestion so far. When printing programs, please include in the text what the inverse video characters are. At times it is difficult to determine what they are.

James A. Kosinski
Pittsburgh, Pennsylvania

Thanks for the suggestion, James. In previous program printouts, we have frequently represented graphic characters in words. In some cases this has confused people. For example, in 16 Pin Bowling (issue #2), we represented a graphic symbol as Graphic 1.

We should have described this as graphic shift 1 to produce the graphic character on the 1 key. This method was also used in Lemonade in issue #1.

ZX QUERY

Before I subscribe to *Timex Sinclair User*, I need to know how useful it will be to me, as I have a ZX81, not a T/S1000.

Kenneth H. Ahrendts
Mingo Junction, Ohio

Good point, Kenneth! The ZX81 and T/S1000 are virtually the same machine. The only difference between them is that the ZX81 has 1K RAM while the T/S1000 has 2K. Everything we publish for the T/S1000 will work with the ZX81 (keeping the 1K difference in RAM in mind). As well, anything written for the T/S1500 will work with the ZX81 and T/S1000 if they have 16K RAM. So don't hesitate to subscribe now!

O CANADA

Congratulations on *Timex Sinclair User*. I have picked up Issue #3 and I shall certainly be subscribing.

Two points: Do you have the address for Timex Canada, and is there a Timex Users Group in Winnipeg or any other Canadian city?

Peter Winter
Winnipeg, Canada

Great to have you as a subscriber, Peter. You join a huge number of Canadians who receive Timex Sinclair User.

To answer your questions: TMX Canada Inc. is located at 635 Hood Road, Markham, Ontario L3R 4N6, and yes, there are Timex Sinclair groups in Canada. We do not have the address of any in Winnipeg but we're sure one of our readers will send the information to us. There is a central club called Timex Canada Computer Club which can be reached through the TMX address.

CREDIT WHERE CREDIT IS DUE

Our apologies to Fred Blechman and Bill Payne, whose respective bylines were inadvertently omitted from the "Binary Banner" and "Setting FORTH" articles in Issue 4. ☺/☺

Write to us

Timex Sinclair User welcomes reader's comments, compliments, queries and complaints. Letters should be addressed to: The Editor, Timex Sinclair User, 49 La Salle Avenue, Buffalo, N.Y. 14214. Please include your full name and address when writing.

Feature

Merging In BASIC

Gary West outlines a technique to do what the T/S manual says can't be done — merge sets of data without using machine or assembler codes

IF you use a T/S1000,1500,ZX81 for data storage and management, you've undoubtedly felt some anguish at its inability to merge sets of data. However, in hacking about with my 8K ROM/16K RAM, I discovered a method by which data sets may be merged — and it's all done in BASIC without the slightest trace of machine or assembler codes.

My problem developed when I wished to examine subsets of larger data sets that I had stored on several separate tapes. From the larger sets (each of which used most of my 16K RAM), I pulled the much smaller subsets and SAVEd each subset on tape. The total number of bytes (that is, the number of letters and numbers) in the combined subsets was under 8K; so all four subsets could easily have fit into 16K at one time. But since each of the four was from separate programs, there seemed to be no way to get them together — unless I re-punched three of them into the fourth.

But with minimal knowledge about RAMTOP and VARS (the first is the address of the byte immediately following the top of RAM, the second the address where the computer begins to store program variables), I was able to "hide" one set of data so that LOADing the next set did not affect the first (and vice versa). After the second set was LOADed, the first was moved out of hiding and I then had access to both.

After LOADing the first data set, you will procede through the steps outlined briefly in Figure 1.

Step	Action	Purpose and Intent
1	*find RAMTOP*	*to know where to begin counting backward to find your hiding place*
2	*lower RAMTOP*	*to create the hiding place (techniques for doing so are described later)*
3	*find VARS*	*to know where to look for the stuff you want to hide (you should note that this address changes every time something is added to or deleted from your program)*
4	*search the files following VARS*	*to find the specific address of the first byte (character) of the data you want to hide*
5	*subtract*	*to find the number of bytes between VARS and your data*
6	*hide data*	*to protect it from the dreaded NEW monster*
7	*NEW*	*to get rid of the program that originally held your data set; your data are well-hidden and will not be found by the wild and rampant NEW*
8	*LOAD second data set*	*to get second set into the computer (this has been the easiest step so far, hasn't it?)*
9	*DIM*	*to create an array that will be large enough to hold both sets of data*
10	*move second set of data to new array*	*to put these data into the new array; then hidden data will soon be moved to join these*
11	*find VARS*	*to know where to look for a place where the hidden data may be moved*
12	*search files following VARS*	*to find the address of the last piece of data you just moved to the new array; the next byte will be the address to which the hidden data are to be moved*
13	*move hidden data back into the light*	*to merge with data that were just placed in the new larger array*

Figure 1

After the final step in Figure 1, the data are ready to be used, assuming that both sets were identically structured. If not, then step 12 could be a search for the beginning byte of the old array and the hidden data could be moved to that address, resulting not in the merger of the data into one array but in the availability of both sets for correlational operations. Both sets are now available to have done whatever it is you wish to do to them.

In order to explain this process, let's look at an example that uses similarly structured data sets: program A has a data array that stores data in strings (50 strings, each containing 32 elements: 1600 bytes of data); program B also stores data in strings (100 strings with 32 elements each: 3200 bytes of data). Merging the data sets would permit better analysis of those data than would be possible if the sets had to be examined individually.

If the hiding place is too small, data will be lost

After LOADing program A, find RAMTOP by ENTERing "PRINT PEEK 16388+ 256*PEEK 16389" as a direct command. The address of RAMTOP will appear at the top of the screen. Write it on a piece of paper (or COPY if you have the ZX printer or the T/S2040 printer). Let's say that we get 32000 as the address of RAMTOP (I get that address when my QSAVE has been previously LOADed; if I have also LOADed the Syntactic Sum routine, my RAMTOP is lowered another 27 bytes).

Since program A has 1600 bytes of data (in its 50 x 32 array), we will need to lower RAMTOP by at least 1600 (we'll actually lower it by 1650 because problems may result if we cut things too closely). We, then, would like to set RAMTOP at 30350 (that 32000-1650). The trick comes in telling the computer to do that.

It's done like this: we found RAMTOP by PEEKing at bytes 16388 and 16389; so if we change the address stored in those two bytes, we will have told the computer to change RAMTOP. To lower (or raise) RAMTOP, divide 30350 (the desired address) by 256 (which has something to do with the value of digits 5 to 8 of a binary number); the result is 118 with a remainder of 142; ENTER as direct statements, the following:

(a) POKE 16389, 118
(b) POKE 16388, 142

RAMTOP is now at 30350.

Now we need to find the address of the variables file (VARS) so that we can look for the data we'd like to hide away. The address of the first byte of the variables file immediately follows the program and the display file (which is the storage place for things you see on the screen). The address of that first byte is important to us because we can count bytes from it to the first bytes of our data and can use that number (with reasonable confidence) to locate our data even if the variables file is moved by lengthening or shortening the program.

To find the address of the variables file and the address of our data, we can put the following routine at the end of our program:

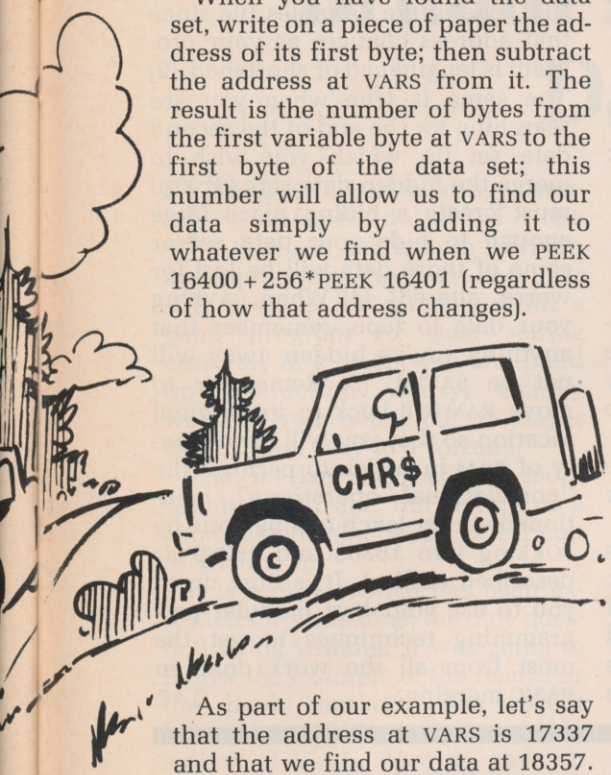
```
9900  LET M=PEEK 16400+256*PEEK
      16401
9905  PRINT M
9910  FOR X=M TO M+3000
9915  PRINT X;"  ":CHR$ (PEEK X)
9920  NEXT X
GOTO9900
```

Line 9900 locates VARS; 9905 PRINTs the address of the variables file; 9910 starts listing at VARS (the 3000 is a dummy counter); 9915 PRINTs each address and the character at each of those addresses; 9920 continues the loop. GOTO 9900 starts the routine; remember not to use RUN because it will wipe out all your data.

Write the address of the first byte of the variables file on a piece of paper.

As the screen fills with addresses and characters, look for the data that we will want to hide. When the screen is full, a code 5 (followed by a slash and some number) will be displayed. Press CONT and ENTER to continue the data listing.

When you have found the data set, write on a piece of paper the address of its first byte; then subtract the address at VARS from it. The result is the number of bytes from the first variable byte at VARS to the first byte of the data set; this number will allow us to find our data simply by adding it to whatever we find when we PEEK 16400 + 256*PEEK 16401 (regardless of how that address changes).



As part of our example, let's say that the address at VARS is 17337 and that we find our data at 18357. The difference is 1020; so our data will (as stated earlier, "with reasonable confidence") always be 1020 bytes beyond the beginning address of the variables file. Our data (which, if you remember back to last week when we started all this) contains 1600 bytes; so the address of the last byte of our data will be VARS + 1020 + 1600 – 1 (we have to subtract 1 because the first byte is at 1020 beyond VARS and not at 1021 beyond that address).

Now that we know where our data are and where the hiding place is (above RAMTOP), all that's necessary is to move the data to the hiding place. To do that, replace lines 9905 through 9920 with the following routine (leave line 9900 as previously entered):

```
9900  LET M =PEEK 16400+256*PEEK
      16401
9905  LET XX=30350
9910  FOR X=(M+1020) TO
      (M+1020+1600-1)
9915  LET XX=XX+1
9920  POKE XX,PEEK X
9925  NEXT X
GOTO9900
```

Line 9900 locates VARS; 9905 starts at RAMTOP; 9910 starts listing at the first byte of the data set; 9915 goes to the next byte in the hiding place; 9920 hides each byte of data above RAMTOP; and 9925 continues the loop. Use GOTO 9900 to start the routine and, again, remember not to RUN anything.

The data set is now hidden, beginning at 30351.

Enter NEW in order to get rid of the program that had originally held the data set. Because we have hidden the data set above RAMTOP, the NEW command cannot find it to wipe it out.

LOAD the second data set in the normal manner. Our second data set (you will recall) contains 3,200 bytes in a 100 × 32 array. In order to merge these data with the hidden data, we must create an array that is large enough to hold both. We would need to add the following line to our program:

```
9900  DIM B$(150,32)
GOTO9900
```

The GOTO 9900 will establish the array we need. After that is done, delete line 9900 (by ENTERing 9900) so that there is no chance of accidentally erasing our data set.

> You must "hide" one set of data before loading another

Please note that the use of B$ is predicated on the assumption that the second data set is not B$; let's assume that our data are in A$(100,32). The following lines will move the data in A$ to B$:

```
9900  FOR X=1 TO 100
9910  LET B$(X)=A$(X)
9920  NEXT X
9930  DIM A$(0,0)
GOTO9900
```

Line 9930 wipes out the old A$ so that there is no chance of confusing A$ with B$ when we begin looking for the specific address of our new data array (B$).

To find B$ in the variables file, place the following lines at the end of the existing program:

```
9900  LET M=PEEK 16400+256*PEEK
      16401
9910  PRINT M
9920  FOR X=M TO M+3000
9930  PRINT X;"  ":CHR$ (PEEK X)
9940  NEXT X
GOTO9900
```

Write the value of M on a piece of paper before beginning your search for B$. You might wish to refer to the comments that follow the similar routine described earlier.

We are now going to look for the last piece of data that was put into B$ because we want to move the hidden data so that it follows the existing data in B$. The hidden data will be moved to fill the remainder of B$.

Continue your search until you have found the address of the last byte of data. The next byte is the location at which the hidden data are to begin. But the displayed address may not be the proper address when the routine is added to move the hidden data (remember that VARS moves as program lines are added or deleted). In order to locate this address later, we need to determine how far this address is from the beginning of the variables file. Later, by adding that difference to the VARS pointer, we can — with reasonable confidence — find the proper byte for moving our hidden data. For our example, let's assume that the difference is 2337 bytes.

In order for the computer to know how to treat the hidden data after they are moved out of hiding, those data must be moved into an array that has been previously designed for accepting those data (that's the reason we DIMmed B$). If the data are moved into the variables file without being made part of an existing array, the computer will not know what to do with those data because the necessary pointers and other things will be missing; thus, you can see the im-

SAVE the merged data as soon as the merger is completed

portance of adding to the data we moved into B$ and you can see the reason for making room in B$ in which to put the hidden data.

Now we know where we want to put our hidden data and we know where we hid it. The following routine will bring the data out of hiding and will place it in the array created earlier:

```
9900  LET M=PEEK 16400+256*PEEK
      16401
9910  LET XX=30350
9920  FOR X=(M+2337) TO
      (M+2337+1600-1)
9930  LET XX=XX+1
9940  POKE X,PEEK XX
9950  NEXT X
GOTO9900
```

To check that your data are correctly merged, add the following lines:

```
9960  FOR X=1 TO 150
9970  PRINT B$(X)
9980  NEXT X
GOTO 9960
```

The two sets of data are now merged into one array. Now you are free to do all those things that typically — though accidentally — happen to damage data sets.

Please remember to SAVE the merged data as soon as the merger is completed.

Let's review some of the areas where problems can be anticipated: (1) You must find the beginning of the data set you wish to hide and you must reference it in terms of its distance from the address of the first byte in the variables file since that address changes as your program is lengthened or shortened. (2) The same is true when you are searching for the end of the second data set (to which you wish to merge the hidden data set). (3) You must create a hiding place large enough to hide your data set or some of those data will be lost (or worse, altered). (4) When SAVEing your data to tape, remember that anything you've hidden away will not be SAVEd. (5) Remember to move RAMTOP back to its original location so that you will have plenty of RAM in which to perform the "correlational operations" mentioned earlier (such can be done by POKEing into 16388 and 16389 as described earlier). It is now up to you to use your best modular programming techniques to get the most from all the work done in BASIC merging. Ø/Ø

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Britain's Software Pioneer Days are Over

THE OLD pioneering semi-amateur days of the Sinclair market in Britain are rapidly coming to an end. It is still possible for someone with a good program to start selling cassettes in a small way and build up production slowly, usually working from home, but no longer is it an easy way to a fortune.

The market has become more sophisticated and the selling of a good cassette can be just as difficult as writing it.

It is a move which has been expected for some time, the only question being whether it was going to follow the example of the record or the book markets. The recent launch here of Virgin Games, a subsidiary of Virgin Records, gave an example of what might be expected if the route was to be that of the record industry. The event took place in a club in London with loud music, large crowds, a Maggie Thatcher impersonator and, almost as an afterthought, the games being shown and their young writers wandering around looking a little lost in all the commotion.

Other record companies which have shown an interest in selling programs for the Sinclair machines are K-Tel which has just signed a deal with DK 'Tronics and Thorn-EMI. Despite the involvement of these companies, it seems more likely the book model will be the one which is followed, with the work split between publisher, duplicators and distributors.

Many of the larger companies which began by writing their own programs in the early days of the ZX81, such as Bug Byte and Quicksilva, are now moving into the area of publishing. They are taking more and more programs from outside writers and doing the marketing for them.

Cassette distribution is also improving fast. Mail order has been losing its dominance ever since W.H. Smith, one of Britain's major news agents and stationers, began selling cassettes. Other major retail chains were slow to follow but now many software houses are signed up with distributors, and retail sales through shops will soon become accepted as the normal way of obtaining new programs.

> Will programs be marketed like records or like books?

Prism Microproducts has been one of the leaders in expanding the retail outlets. A sister company of ECC Publications which publishes *Timex Sinclair User*, Prism has signed a deal with Rumbelows, a nationwide chain of electrical retailers, to begin a rack jobbing system. Rumbelows' shops have special displays which are serviced regularly by Prism employees, replacing stock which has been sold and taking out slow-moving cassettes and putting in new ones.

The company is also looking at alternative distribution systems. It has been appointed exclusive distributor for Romox in the U.K. Romox is a California-based company that has developed a system for selling games on cartridge. Each retailer has a terminal which allows cartridges to be recorded in the shop, using either a blank tape or one that has been erased. It allows the retailer to carry no stock other than blank cartridges, and the distributor can immediately make new games available by putting them on the terminal.

The system is not yet available for the Sinclair machines, but if a test market being done in Birmingham in the autumn proves successful, it cannot be long before it arrives.

The effect of these changes has been to raise the threshold of entering the Sinclair market. It is still possible to follow the amateur route of writing a program and selling it through a small advertisement in *Sinclair User*. This will no doubt continue to prove profitable but for a program to make really large sums it will now need a major launch. Without strong financial backing and a supporting catalogue of other software that would not be possible.

While there are many people who have been involved with Sinclair computers since the early days of the ZX80 who are a little sad that the old easy-going times may be over, it is recognized that it is a change which must happen if home computing in Britain is to become a major leisure industry in the next few years.

— Nigel Clark
in London

Locking Up

How to prevent nosey people from LOADing your programs?

On your 16K machine, type in:

```
POKE 16388,255
POKE 16389,127
NEW
POKE 32767,n
```

This sets RAMTOP down 1 byte; the secret code number "n" may be any integer in the range 1 to 255 except 62.

Now type in or load the program to be protected and add the following lines:

```
9960 STOP
9970 SAVE "program name"
9980 IF PEEK 32767 <> n THEN
RAND USR 0
9990 GOTO start
```

To save, type GOTO 9970.

To load, do step 1 and load normally. If your code number n is at 32767 the program will run automatically; otherwise it will vanish without a trace because USR 0 has the same effect as pulling out the power supply. Don't forget your code number!

Values for other memory sizes:

	1K	2K	16K
POKE 16388	255	255	255
POKE 16389	67	71	127
Code Addr.	17407	18431	32767

RAMTOP may, of course, be set to any lower value.

— Thomas Bullock

Saving Memory

Two methods of memory saving coding are the use of CODE to assign or test for many variable values between 0 and 255, and PI-PI for the value of zero. To see the relative value of these two as memory savers I tried the following programs. The idea was to initialize the value of four variables, A,B,C,D to 0. Not shown is line number 99 which prints the size of each program. It is:

```
99 PRINT "CODE LENGTH IS"; PEEK
16396 + 256 * PEEK 16397 - 16580
```

Here are the results:

10 LET A = 0 20 LET B = 0 30 LET C = 0 40 LET D = 0	10 LET A = 0 20 LET B = 0 30 LET C = 0 40 LET D = 0
Takes 60 bytes	Takes 54 bytes
10 LET A = PI-PI 20 LET B = PI-PI 30 LET C = PI-PI 40 LET D = PI-PI	10 LET A = 0 20 LET B = A 30 LET C = A 40 LET D = A
Takes 44 bytes	Takes 42 bytes
10 LET A = PI-PI 20 LET B = A 30 LET C = A 40 LET D = A	10 LET A = CODE "" 20 LET B = A 30 LET C = A 40 LET D = A
Takes 38 bytes	Takes 38 bytes

As you can see, the use of these techniques can save that extra byte or two to squeeze those display burdened programs into your budget bound RAM.

— Chip Hacker

RAM Pack Wobble, Solution 17

Blue No More

The following tip comes from a reader in Clay, New York:

"It was with considerable interest that I read about the "RAM pack blues" in the *Hints & Tips* section of Issue #1. I purchased a T/S1000 and 16K RAM for my nine-year-old son, and he soon attained a state of total frustration because of its erratic behavior. I myself spent many late hours trouble-shooting, thinking the problem might be tied to certain programming routines indicating a fault in the chip. Eventually I stumbled upon the obvious: the imperfect connector system for the RAM.

Copying More or Less than the Standard 22 Lines

Those who own the ZX or Timex Sinclair printer have probably found that the COPY function copies the 22 lines of the screen normally used by the computer. What do you do if you want to COPY only the top 10 lines or the entire 24 lines of the screen? You end up wasting 12 lines of paper in the first case, or having the bottom of your display copy left uncopied in the second. This short, simple machine code routine allows you to specify the exact number of lines you want copied.

The COPY routine in the Sinclair ROM starts by loading the D register with the number of lines to be copied. In this routine, we just load the D register with the number of our choice and jump to the rest of the COPY routine (086B).

Enter the following program:

```
 1 REM (five spaces long)
10 POKE 16514,22
11 POKE 16515,10
12 POKE 16516,195
13 POKE 16517,107
14 POKE 16518,8
```

Run the program. The listing will now look like this:

```
 1 REM -▒??▒
10 POKE 16514,22
11 POKE 16515,10
12 POKE 16516,195
13 POKE 16517,107
14 POKE 16518,8
```

Delete lines 10, 11, 12, 13, and 14. They are no longer needed. The machine code has been installed in the 1 REM line.

Now try writing the following program:

```
 1 REM -▒??▒
10 FOR N=0 TO 21
20 PRINT N
30 NEXT N
40 RAND USR 16514
```

The screen's lines will be numbered 0 to 21, but when the program reaches 40 RAND USR 16514, only the first 10 lines of the screen are copied.

The machine language program is:

Decimal	*Mnemonics*	*Hex*
22, n	LD D,n	16, n
195, 107, 8	JP 086B	C3, 6B, 08

The character n in the first instruction is the number of lines of the screen that you want to have copied. The number can easily be changed by POKEing 16515 with another number. Any number between 1 and 24 can be POKEd.

The routine can be called by RAND USR 16514.

Should you want to PRINT on all 24 lines of the screen as well as being able to copy all 24 lines, just incorporate in your program, POKE 16418,0. You will be able to PRINT on the bottom two lines of the screen. The command POKE 16418, 0 must be incorporated within the program; it has no effect if done in the immediate mode. If you have POKEd 16418 with zero, you *must* POKE 16418 with a 1 or 2 prior to an input of a variable; a crash is guaranteed otherwise. An alternate way of entering variables when you are using all 24 lines of the screen is through the use of INKEY$. ∅/∅

— David N. Hoshor

"My solution is considerably less expensive than various products that sell for as much as $35.95. Very simply, I have found that a large rubber band does an admirable job of securing this connection. I have been utilizing this system for over five months (yes, I also enjoy this remarkable computer); I am on my second rubber band as the first failed after four months. My son is now thoroughly enamored with the world of computers.

"I considered taking an ad in *Timex Sinclair User* to offer this revolutionary product for, say, "$5.95 + postage" to one and all, but decided that doing so would be 'highway rubbery.' So I freely relinquish all rights to this idea to the users and owners of T/S1000s and ZX81s around the world."

— John M. Thompson, Jr.

PHOTOGRAPHY • Bernie Prost

T/S Entrepreneurs

Dennis J. Krill of the Central Pennsylvania group describes the products that originated within his group

THE Central Pennsylvania Timex Sinclair User Group meets for about two and a half hours each week. We encourage open discussion on all levels, from beginner to expert, for there is no better way to educate everybody. Our membership currently numbers about 120.

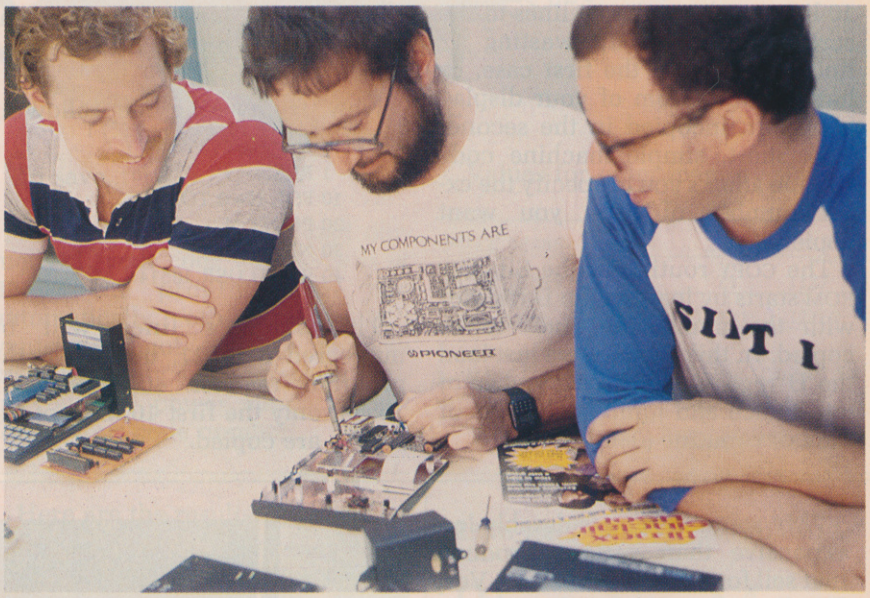
The unique aspect of our group is the amount of innovation that has resulted from our discussions. All members benefit from experimentation resulting from questions.

Bill Russell, for instance, has developed hardware that not only filters the signal between the machine and tape recorder, but virtually guarantees a good load every time. The large amount of requests for his Winky Board forced him to start his own company (G. Russell Electronics) in order to manufacture Winky Board II. The device was the result of the question, "Why do I have so much trouble when loading programs from tapes?" But Russell is not limiting himself to one item. He is currently developing a Winky Board that will operate with 10 tape recorders (for commercial use) as well as a line of software.

The experimentation of Brad Bennett is also providing benefit to all users. His ZXLR8, available from Advanced Interface Designs (his own company), will raise the baud — the speed at which the machine accepts information. His method will load from a tape recorder six times faster than normal. Bennett has produced two items that will achieve this result: (1) software tape, and (2) an EPROM that is piggybacked onto a chip located on the machine circuit board.

Bennett did not stop there. His inquisitive nature led to the development of a high resolution graphics board. With this hardware, he is able to display, among other things, a histogram which would aid his development of a speech recognition module. At a recent meeting, he demonstrated his machine's ability to recognize the spoken word by correctly displaying any word previously programmed. For instance, one member programmed his histogram for numbers from one to 10. He then randomly chose a number and spoke into a microphone. To the amazement of all, that number was printed onto the television screen by the computer. The same result was accomplished with words.

John Kennan, who until his purchase of a ZX81 kit was a relative newcomer to computers, has developed a series of software routines to aid his programming efforts. Key allows the user to stop and list machine code programs. Using the 'protect' and 'merge' sequences, a user can store a program above RAMTOP while working on another program. Kennan's background in chemistry requires this capability to be incorporated into his programming. However, members from other disciplines have utilized Key in their work. Key is also available from G. Russell Electronics.



*Brad Bennett (**left**) and Roger DeAngelis look on as Dennis Krill (**center**) makes the final connection to his inverse video modification.*

PHOTOGRAPHY • Bill Russell, Dennis Krill, Brad Bennett

Roger DeAngelis's background in statistics brought about his SIFT I and SIFT II packages. This software will not only perform statistics calculations and plots but will also educate a user with no previous statistics knowledge. DeAngelis wrote his programs in a compressed form to allow them to be run on a 2K base machine. Included with his package (available from Compucraft) is a thorough manual.

Bob Heil is currently preparing to teach a Beginner's Course — based on the T/S1000 at a local business school. Heil has been using the computer for only six months.

Many of the members have not only wired their own typewriter-size keyboards but are also customizing this hardware by experimenting with special dedicated keys. We have found this capability necessary when we run our own programs. Specific uses are: single key edit, delete and arrows (no need to press shift); calculator style number pad; and user defined functions. Some have developed a "plug-in" technique using DIP sockets. This affords use of the large keyboard while maintaining the portability of our machines.

Dennis Krill (graphics background) required an inverse video capability in order to cut down on eyestrain while drawing on the screen. Internal addition of a circuit board along with modifying the video output to UHF has cleaned up his display. Other members are now making similar modifications.

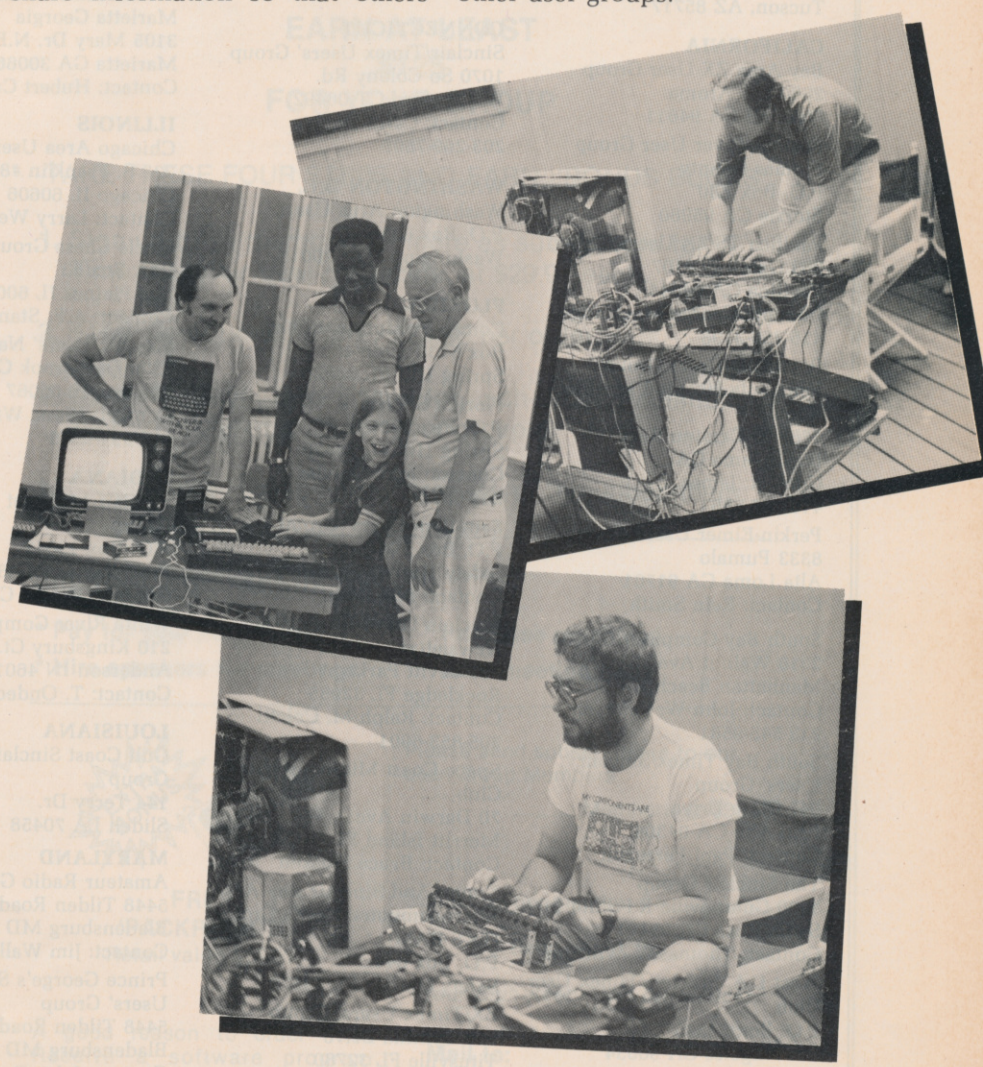
A most unique innovation has been devised by Rich Irace. A student at Lock Haven State College, Irace installed a T/S1000 into a robot he is constructing for an engineering class. Included will be a speech module. When the robot "talks" a series of LEDs will blink to give the appearance of a mouth opening and closing.

In order to maintain communication with other user groups, publications and manufacturers, our group produces a monthly newsletter, *Synapse*, in which we publish programming tricks and discoveries, software and hardware reviews as well as interesting routines that might be useful to others. We consciously attempt to share information so that others may benefit from our discoveries.

One group member is developing a speech recognition module

Our library contains 75 programs, 12 books and a complete collection of available T/S,ZX related publications. With this information, an individual can test an item before spending money on something that will not satisfy his needs.

To date four companies have developed from our group. They are G. Russell Electronics, Advanced Interface Designs, Compucraft and Kennan Software. We are always interested in hearing from other user groups.



Scenes from the Pennsylvania group (clockwise from top): Bill Russell operating Roger DeAngelis' work center; Dennis Krill using DeAngelis' full-size keyboard and equipment to test a graphics idea; Katie DeAngelis demonstrating a program.

National Listing

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The articles in this series are excerpts from the book, "Programming Arcade Games," soon to be published by Reston Publishing of Reston, Virginia.

Part I of a new five-part series
by Bob Fraser

Programming Arcade Games

THE computer language BASIC is a summarized, user-oriented system which permits you to communicate easily and painlessly with the computer. Each command in BASIC is translated by the machine into a series of primitive instructions known as machine code. Groups of these instructions performing specific functions are called functional groups or macros.

Thus the PRINT statement involves a series of machine code operations enabling the required information to be displayed on the screen.

We now can see that BASIC simplifies program writing and at the same time increases programming speed. However, because it involves commands that require further internal code, the execution time suffers. Programming ease has increased at the expense of speed of program performance. This is apparent in a comparison of screen movements using BASIC and straight machine code.

Still, the speed of movement in BASIC is quite sufficient for many game and program applications.

BASIC: Fast to program but slow to move.

Machine Code: Slow to program but fast to move.

There are three methods to move objects on the screen: using the PLOT/UNPLOT statements; using the PRINT AT statements; using PEEKs and POKEs and system variables.

PLOT/UNPLOT statements are used in conjunction with a single picture element called a pixel. For the standard T/S1000, ZX81, the screen is composed of 64 x 44 pixel positions.

To access a location, type in the co-ordinates of that location (To designate co-ordinates, specify column and then row.) Thus, to plot a point at (3,2), type PLOT 3,2. To erase this point, type UNPLOT 3,2.

The columns across have one extra non-printable position called the ENTER character. Its use will be described later.

Type in

```
10 FOR I=1 TO 20
20 PLOT I+4
30 NEXT I
```

and run it. What you will observe is a straight line being plotted across the screen at Y=4 and X=1 to 20, one point at a time.

Add this statement to your program:

```
15 UNPLOT I-1,4
```

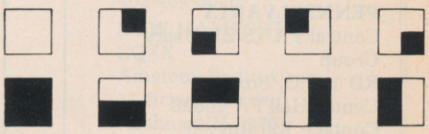
and run it once again. What you now observe is a pixel moving individually across the screen — in other words... animation!

Unfortunately, the motion is very slow and limited to the specific shape of the pixel. However, you have now seen the underlying principle of moving an object across the screen; printing it and then erasing it through consecutive points. This is very similar to the apparent movement of lights on an electric sign — the lights simply go on and off in succession to create the illusion of movement.

For practice, try producing a pixel that moves down the screen or back across the screen in the other direction. (Hint: Erase behind the pixel by erasing the I+1 position.)

PRINT AT statements are far more powerful than PLOT/UNPLOT statements because they allow for different characters to be printed, and you can create faster movements.

The PLOT statement is slower because it involves a large group of subroutines that are used to create the continuity of the small pixel. The PRINT AT statement avoids those subroutines. The actual small graphics character (first four illustrated characters) is not part of the character set available to the user. Thus to create a line of pixels, the machine code subroutines of PLOT statement must calculate grid positions and combine the standard graphic characters to produce the desired continuity.



The overall effect is a motion that is slow, made so by the extra time required to run those subroutines.

PRINT AT 3,2 prints on the third row down and the second column across.

Type this short program in:

```
10 FOR I = 0 TO 31
20 PRINT AT 3,I;"*"
30 NEXT I
```

When you run this program, a

series of *s will be printed across the screen. Notice how the speed has increased. Let's create a single * moving across the screen now. Be sure to remember the key to the movement effect from section (1). Change statement 20

```
20 PRINT AT 3,1;" *"
```

and run the program again. The key is the addition of the blank space " " inserted before the *.

PEEKs, POKEs and system variables are used to obtain a smooth vertical motion when moving a single character. The motion will be as smooth and fast as horizontal motion.

These definitions are needed to understand this method:

System Variables: These are fixed memory locations in main memory that contain "book-keeping" information on the state of the computer. The PEEK statement is a method of looking into this area and seeing what is contained. The POKE statement allows you to place a number into that location.

D-FILE System Variable: This variable contains the start of the display file. The actual address of the start is a changeable number, the size of which is dependent upon the size of your program. The display file is the location of all the characters that are visible on the screen.

ILLUSTRATION • Don Kletke

Figure 1

```
    5 REM SET D EQUAL TO START OF
  DISPLAY FILE
   10 LET D=256*PEEK 16397+PEEK 1
6396
   13 REM START OF POKE ANIMATION
   15 PRINT AT 12,15;"POKE "
   17 REM PRINTS A * ACROSS THE
   SCREEN
   20 FOR I=34 TO 64
   30 POKE I+D,0
   40 POKE I+D+I,23
   50 NEXT I
   55 REM PRINTS * DOWN THE
SCREEN
   60 FOR I=65 TO 628 STEP 33
   70 POKE D+I,0
   80 POKE D+I+33,23
   90 NEXT I
   93 REM      START OF PRINT AT
SECTION
   95 PRINT AT 12,15;"PRINT"
   97 REM PRINTS A * ACROSS THE
     SCREEN
  100 FOR I=31 TO 1 STEP -1
  110 PRINT AT 19,I-1;"* "
  120 NEXT I
  130 FOR I=19 TO 2 STEP -1
  140 PRINT AT I,0;" ";AT I-1,0;"
*"
  150 NEXT I
  152 REM START OF PLOT SECTION
  155 PRINT AT 12,15;"PLOT "
  157 REM PLOTS LEFT TO RIGHT
  160 FOR I=4 TO 58
  170 UNPLOT I-1,38
  180 PLOT I,38
  190 NEXT I
  191 REM PLOTS DOWN
  200 FOR I=38 TO 5 STEP -1
  210 UNPLOT 58,I
  220 PLOT 58,I-1
  230 NEXT I
  235 REM PLOTS RIGHT TO LEFT
  240 FOR I=58 TO 4 STEP -1
  250 UNPLOT I+1,4
  260 PLOT I,4
  270 NEXT I
  275 REM PLOTS UP
  280 FOR I=4 TO 37
  290 UNPLOT 4,I
  300 PLOT 4,I+4
  310 NEXT
  315 REM START THE WHOLE THING
OVER AGAIN
  320 GOTO 10
```

Here is a graphic representation of the memory:

SYSTEM VARIABLES	PROGRAM AREA	DISPLAY FILE	OTHER AREAS
16384	16509	?	?

The display file address occupies two bytes of storage (16396 and 16397). Thus to access the address you use the statement:

LET D=256*PEEK 16397+PEEK 16396

after which D will contain the address of the first character position for the screen. Try this sequence:

```
10 LET D=256*PEEK 16397+PEEK 16396
20 POKE D+1,23
```

What you will see is an * appearing at row 0, column 0, on your screen; i.e., start of screen address + 1.

To access any point on the screen add the position number to the starting address of the screen which is:

256*PEEK 16397+PEEK 16396

Using Appendix A of the T/S1000 ZX81 manual, look up the various codes of the characters and POKE them into the various locations on the screen. Example: (a) Set D=256*PEEK 16397 +PEEK16396 (D=the start of the display). (b) Find the code of the * character; this turns out to be 23 (first column in the Appendix A table). (c) Print the * on the second row third column POKE D+36,23, then press ENTER (33 spaces across the first line + three spaces on the second line).

The * will appear upon initiating the last statement.

The POKE statement replaces the complicated PRINT AT statements. The POKE contains fewer machine code components and thus executes the program a little faster.

To erase a character, POKE a 0 into that location.

The program in figure 1 illustrates the three different speeds of motion across the screen. It will continually run, displaying the titles POKE, PRINT and PLOT during which time either the * or the pixel will run around the screen, using the statement indicated on the screen. The program will clearly compare the speeds and smoothness of motion for the three animation methods.

NOW that you have mastered motion on the screen, the next stage is to control the direction of the motion from the keyboard. To do this, you must use the INKEY$ function.

This function: (1) has no arguments; (2) reads the keyboard; (3) doesn't wait for you, so you don't have to type ENTER.

When you use the function, action will be taken only if the specified key has been pressed.

The short program in figure 2 will allow you to move an * across the screen. The * will move left when you press the 7 key and move right when you press the 0 key. (The * appears after you press either the 7 key or the 0 key to start.)

Now to move the * up and down, add the lines in figure 3 to your program. (Statements 58 and 59 create the effect of movement.) This program is the basis for an arcade type game.

Firing At The Invaders

The next stage is to add a firing feature. You must have some way of destroying those "invading alien hordes". These statements are once again an offshoot of the same method of creating motion. Add these lines to your program:

```
57   IF K$="L" THEN GOSUB 1000
1000 FOR I=C+2 TO 30
1005 PRINT AT R,I; "-"
1010 NEXT I
1020 RETURN
```

When you press L the program goes to the subroutine at statement 1000. This initiates a firing sequence by printing a dash (-) across the screen. If you wish to see the line of fire, simulating a laser, take the blank out of statement 1005.

Checking In Front Of You

In summary, the program allows movement up, down, left, and right. It can fire lasers or rockets. The last detail is a quick check to see if you have hit anything. To do this you can use the system variable of DF-CC at memory addresses 16398 and 16399.

To use this feature add the lines in figure 3 to your program.

Figure 2

Program	*Explanation*
10 LET C=10	*Initializes the column to 10*
20 LET K$=INKEY$	*Sets K$, will contain the key value you press*
30 IF K$=""THEN GOTO 20	*Loop waits for you to press a key (INKEY$ is an ongoing search process)*
40 IF K$="7" AND C=2 THEN LET C=C-1	*Checks to see if you have pressed a "7". If so, and you aren't at the left border, the column number is decreased. (i.e. the "*" will be printed one column to the left of the old location.*
50 IF K$="0" AND C=29 THEN LET C=C+1	*Checks to see if you pressed "0". If so, and you aren't at the right border, the column number is increased. (i.e. the * will be printed one column to the right of the old location.*
60 PRINT AT 15,C;"*"	*Prints the *. Notice the blanks on either side of the *. (Remember what they do?)*
70 GOTO 20	

Figure 2A

5 LET R=2	
55 IF K$="1" AND R=L THEN LET R=R-1	*Checks to see if the "1" key has been pressed, moving the "*" up.*
56 IF K$="4" AND R=18 THEN LET R=R+1	*Checks to see if the "4" key has been pressed, moving the "*" down.*
58 PRINT AT R-1,C;" "	*Prints a blank above the "*".*
59 PRINT AT R+1,C; " "	*Prints a blank below the "*"*
60 PRINT AT R,C; "*"	

Figure 3

1006 PRINT AT R,I+2	*Checks screen position. If the byte contains the start of the alien then it branches out to 2000 where a message is printed out. In other words you have made a direct hit!*
1007 LET P=PEEK(256*PEEK 16399+PEEK 16398)	
1008 IF P=155 THEN GOTO 200	
2000 PRINT AT R,I-3; "BANG"	
2005 PAUSE 30	
2010 PRINT AT R,I-3;" "; AT R,I;"*"	
2020 GOTO 40	

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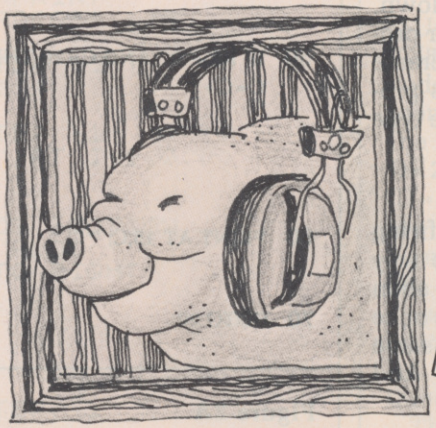

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FORgive and FORget

Our apologies to our readers for omitting the keyword FOR from line 40 of the program Minotaur in our third issue. The line should have read:

```
40 FOR M=1 TO 19 STEP 2
```

Sorry for the inconvenience.

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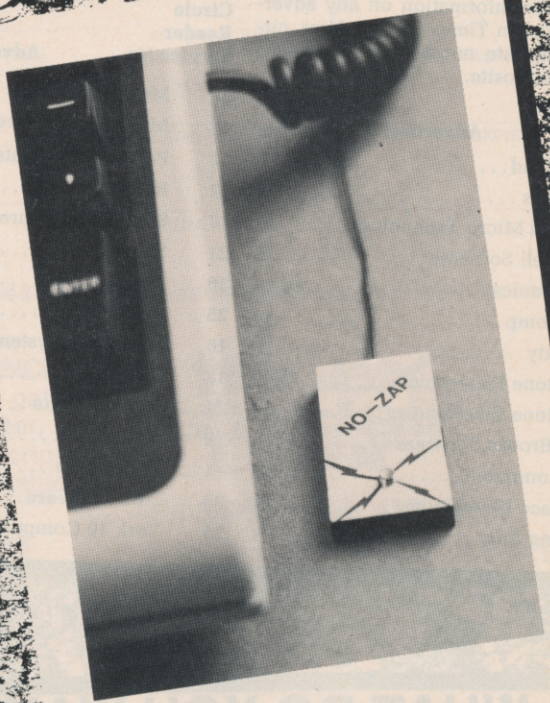

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